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EXCLUSIVE RATINGS

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Best Computer and
Software Companies



PLUS First Looks:
Flat-Screen Monitors
For Every Budget



John C. Dvorak:
What Microsoft Gains
From the DOJ Lawsuit

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THE INDEPENDENT GUIDE TO PERSONAL COMPUTING

VOL. 17 NO. 13

JULY 1998

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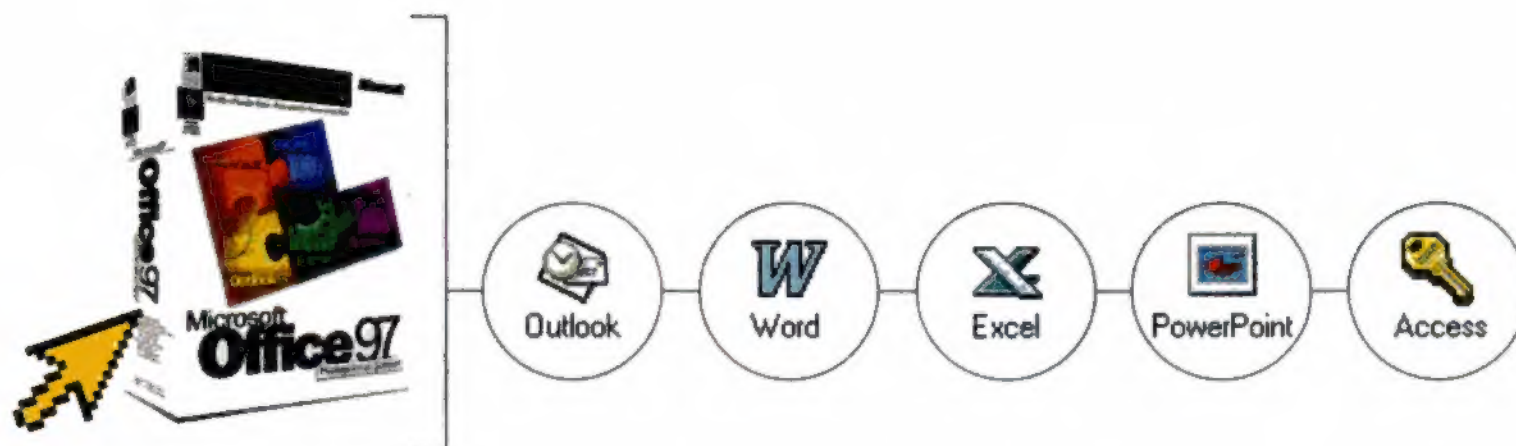


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A Long Way from Perfect



Every year at this time, we present our annual guide to what we think you should be looking for in different kinds of systems. From a “dream machine” to more reasonable models for your home, your office, or

traveling, these are our “Perfect PCs.” Also every year at this time, we get the results from our survey of what you

are finding about the reliability of your machines and the service you get from vendors. This is the largest canvass of its kind in the industry, based on a projectable sample of *PC Magazine* subscribers, and the results help us all gauge how well computer, printer, and software vendors are doing their jobs.

As such, the survey results are a good way of comparing vendor differences. Most readers rate their PC, printer, and software makers highly. That’s the good news.

The bad news is that the results for frequency of service are far from encouraging. In the past year, on the surveys that were returned from more than 7,000 randomly selected people, about 7,000 of the 21,000 desktops and notebooks mentioned required some service or support. That’s 33 percent.

That’s not “perfect.” It’s terrible.

The numbers are probably better than those you would get if you asked the same question of people with cars. But cars require regular maintenance. A PC is different, and that’s particularly relevant in an industry that likes to talk about PCs converging with consumer electronics devices. After all, how often does your stereo or television need service?

What’s the problem? Well, for one thing, computers are more complex than most electronic devices. Unlike products that are designed to do just one thing, PCs are designed to do just about everything.

But that excuse is not good enough. The real problem we have with PCs is that they are designed more for maximum flexibility than for maximum reliability. I like the flexibility but worry that we need something more stable and much easier to maintain.

Take Windows 95. Please. It’s not that there’s anything better today, but Windows simply crashes too

often. (So do Macs, in case you’re wondering.) Yes, Microsoft says Windows 98 fixes almost 3,000 bugs, but that begs the question of why those bugs were there in the first place.

The problem isn’t in the specifics of the code; in any software as complex as Windows, you have to expect some errors. The real problem goes back to software trade-offs.

For one thing, Windows is designed to be able to run old DOS programs, because we want backward compatibility. For another, Windows is designed to let programs share components (such as DLLs). Each new program can write new versions of these shareable components, creating potential problems for other programs. And yet another: We all want the ability to add new or updated drivers for third-party hardware, but some peripherals vendors emphasize speed far more heavily than reliability.

In the future, we want operating systems that combine the underlying protection features of Windows NT with the compatibility and the plug-and-play and installation features of Windows 95/98.

Or take the basic PC design. One example: I’m running out of interrupts. And again, part of the problem lies in the desire to maintain compatibility. Having backward compatibility is nice, but the ISA bus ran out of steam almost a decade ago. We’d have more stable systems if just about everything other than memory ran on USB or 1394 (except for graphics, which runs on AGP).

So what should we do? At this point, I’m willing to throw out ISA, and I’m ready to leave the old DOS applications behind, though not without some regrets. But I’m not going to trade off ease of administration or, more important, the flexibility of running new software and new hardware.

Microsoft, Intel, and others are talking about moving in this direction. As far as I’m concerned, the faster we get there, the better. Because we all want a more Perfect PC.

A stylized, handwritten signature of Michael J. Miller in black ink.

MICHAEL J. MILLER

WHEN SOMEONE YELLS OUT "HEY, GEEK" DO YOU TURN AROUND?

If so, you should be buying your systems from Micron. We're so popular among the technology savvy set that the readers of *PC Week* just voted Micron #1 in overall customer satisfaction. Four out of five geeks (the fifth just goes off and builds their own) prefer Micron because they recognize Micron's engineering driven, award-winning product focus is unmatched in the PC industry. They also know that Micron™ systems are very dependable, use the finest quality components and are backed up by our responsive and knowledgeable tech support and sales force – at prices that you wouldn't expect to find from a top-tier \$2 billion direct systems manufacturer.

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SPECIAL ISSUE

The Perfect



For many people, the words *The Perfect PC* will always and forever conjure up an image of the ultimate “dream machine,” a high-end powerhouse loaded with all the latest, most cutting-edge components—whatever this year’s version of those items happens to be. But that’s only one of several “Perfect PCs” in today’s diverse reality. Each of the systems we describe in this issue is well suited—that is to say, *perfect*—for particular tasks or a specific market.....100

SPECIAL PULLOUT SECTION

How to Choose The Perfect PC

BY ANUSH YEGYAZARIAN

If you’re already collecting reviews and tearing out ads as you shop for a new PC, we’ll help you get down to a short list with our updated guidelines and worksheet. For starters, we recommend you buy as much processor as you can afford, to make your investment last. If price is key, you’ll do better a level or two down from the top CPUs. Whether you’re after a dream machine or a value notebook, we’ve got some useful guidelines for you across six PC categories.....125

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READERS RATE SERVICE & RELIABILITY

Desktops and Notebooks

BY MARY E. BEHR AND GORDON PLUTSKY
Few companies earn an A on this year's Readers' Report Card. Dell, Hewlett-Packard, IBM, and Gateway lead the pack in our annual survey219

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READERS RATE SERVICE & RELIABILITY

Printers

BY SAMANTHA J. EDWARDS AND JOSH LEVY

Along with Epson, Hewlett-Packard also earns an A from readers for printer service and reliability. That means they received better-than-average scores on four key measures, including technical support and repair experience241

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READERS RATE SUPPORT & SATISFACTION

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BY SAMANTHA J. EDWARDS

When do the Oscars and users' satisfaction with software get mentioned in the same breath? Answer: When it's the 1998 PC Magazine reader survey—and we find lots of readers very satisfied with software and software vendors247

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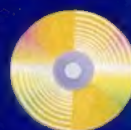
- Talk back to Dvorak, Miller, Willmott, and all our other columnists.



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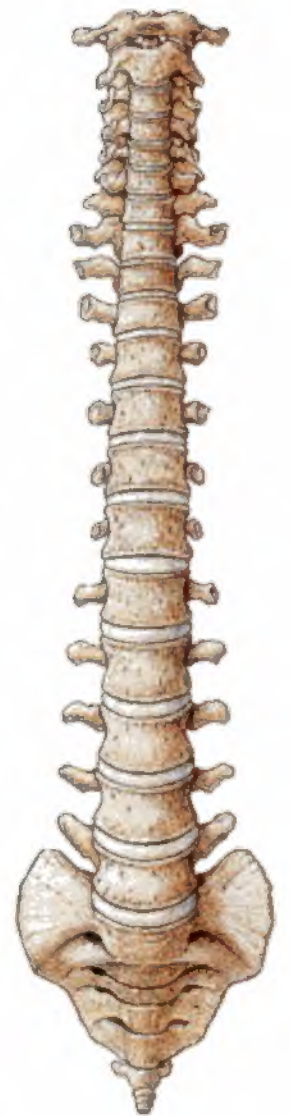
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CAN WE BUILD ONE FOR YOU?

Pipeline

Apple's New Shine

Apple's Web site bills it as "the jaw-dropping rocket computer." What is it? It's the iMac, a sleekly designed \$1,299 consumer machine with one-button Internet access and a translucent blue case that glows when the system is on. The new iMac, based on a 233-MHz G3 processor, will square off with low-cost PCs such as the Compaq Presario.

According to Apple's interim CEO, Steve Jobs, Apple is pinning its future on the G3-based iMac line of desktop machines and a new line of low-cost G3-based PowerBook portables. Jobs said he hopes to see the iMac woo PC buyers to the Mac platform.

The hardware announcement came during the same week that Jobs announced that Apple will com-

bine its current Mac OS with elements of its operating system Rhapsody into a new offering called Mac OS X. The move represents an effort to keep software developers from defecting to other platforms.

They won't have to rewrite applications completely to work with Mac OS X, as they would with Rhapsody.

Do these moves come in time? That's the key question for Apple.

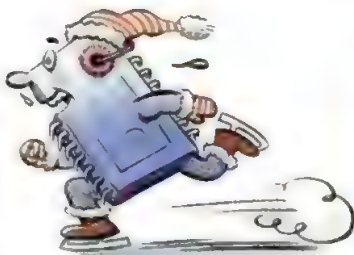
Developers greeted the announcement of the new operating system favorably, though some criticized Apple for backing off of the cutting-edge technology in Rhapsody. And there has been some good news lately for Apple. According to Jobs, the Apple Store Web site is getting 10 million page requests a day, up significantly from 1 million last summer.



Souping Up by Cooling Down

Your next computer may come with a freezer. Kryo-Tech, based in West Columbia, South Carolina, recently demonstrated what is possibly the fastest single-processor Windows NT workstation ever. It's a Digital Equipment Corp. system with a 600-MHz Alpha 21164 that's overclocked to 767 MHz. The system maintains thermal stability by cooling the processor down to -40° C. Kryo-Tech also demonstrated a 300-MHz AMD K6-based system running at 400 MHz.

Taking advantage of the fact that microprocessors can run faster at lower temperatures, KryoTech uses vapor-phase refrigeration similar to your refrigerator's, letting CPUs run safely at 30 percent above their rated speed. KryoTech plans to sell the Digital system retrofitted with the technology this summer. The refrigeration adds about \$5,000 to the system's cost.



The Feds vs. Microsoft

68%

of respondents to a PC Magazine Online poll, taken just after the Justice Department launched its attack on Microsoft, said that Microsoft had demonstrated monopolistic behavior.

Code Name: Bluetooth

Notebook PCs, cellular telephones, and PDAs have been a boon for the traveling businessperson, but there's just one problem: For every device you add to your mobile computing arsenal, you must have another wire, cradle, or adapter to connect that device to your PC.

Ericsson, IBM, Intel, Nokia, and Toshiba have come to the rescue with Bluetooth—a low-cost wireless solution based on short-range radio technology. (It's named after tenth-century Danish king Harald Bluetooth, credited for uniting all the provinces of Denmark.)

Bluetooth uses the 2.45-GHz ISM (Industrial Scientific Medical) frequency band of the radio

spectrum, which is free and isn't licensed by the FCC. Via a small radio transceiver, Bluetooth devices can exchange voice and data at speeds up to 1 Mbps within 10 meters, or within 100 meters with an optional amplifier.

So imagine sitting in an airport lounge and browsing through your e-mail, which has been transferred wirelessly from your notebook in your briefcase to your mobile phone. No cables, cradles, or adapters.

Casio, Lucent, Motorola, Psion, 3Com, and VLSI plan to build support for Bluetooth in products scheduled to hit the market next year.



www.pcmag.com

PC Perfection: All the Details You Need

This issue's cover story on 1998's Perfect PC continues online, with guides to the features and specifications of the best systems.

Have a Laugh With ARF Online

Yes, computing can be funny, and we're proving it with the Web debut of Abort, Retry, Fail?

PC Tech's Top Ten Downloads

We keep a running tally of our most popular downloads. Get the utilities everyone's talking about.

Second Looks: Voice Your Opinion

You've used the products, now tell us what you think. We're asking for your opinions every Friday.

New-Product News Briefs

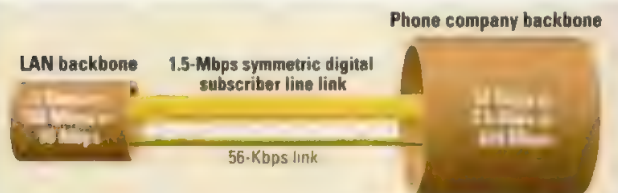
Who's coming out with 400-MHz PCs? Have you seen the new offbeat Web browsers? Bookmark our improved new-product announcements.

Pipeline

DSL for Corporate Networks

A corporate network may be fast, but the link to the phone company—and the wide area network—is likely to be slow. Some two-thirds of U.S. businesses have only a 56-Kbps connection to the phone company.

The problem lies with the phone company equipment, which uses time-division multiplexing. It's an old approach that dedicates fixed



amounts of bandwidth for voice calls but is inefficient with *bursty* data, which is sent in spurts. LANs use the more efficient *statistical multiplexing*, in which everyone on the network shares bandwidth.

Start-up AccessLan Communications has developed a line of routers and concentrators—based on symmetric digital subscriber line technology—designed to upgrade the phone companies, letting them offer 1.5-Mbps data services at the cost of 56-Kbps services.

Computers That Think and Feel

Will consciousness arise if you put enough quantum physicists, neurosurgeons, parapsychologists, philosophers, neurophysiologists, and artificial-intelligence researchers together in one place for a week and turn up the heat?

That's the question put to the test every two years at the Toward a Science of Consciousness conference, sponsored by the University of Arizona. At this year's gathering, talk swirled around the concept of machines that could think, pay attention, and even have internal, subjective experiences as we humans do.

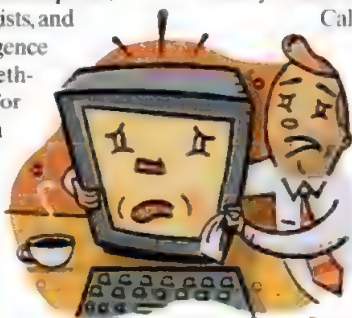
What might intelligent video-game adversaries someday have in common with intelligent buildings that could protect occupants from catastrophe? One answer is selective attention, a property of consciousness we've all experienced—for

example, when conversing with a friend while driving only to realize we've hardly noticed the scenery. Researchers from

Caltech and the University of Illinois in Urbana-Champaign have implemented selective attention in a video game called *Desert Survival* (<http://sunoptics.caltech.edu/~george/DesertSurvival>).

By focusing on what's absolutely essential, the game can react to survival-threatening events in real time.

Meanwhile, physicist Jack Sarfatti, of the Internet Science Education Project in San Francisco, has proposed the Q-Chip—a microprocessor based on the interaction between a physical system's quantum-mechanical space and the mind's "configuration space." With an infusion of around \$3 billion, the Q-Chip could become reality in five years.



Are You Under Surveillance?

It's 9:00 A.M. Do you know where your employees are surfing? According to Surf-Watch Software, a maker of Web filtering software, there's about a 50 percent chance that they're visiting "undesirable or unproductive" sites. In response, about half of U.S. companies have guidelines that specify in plain English the dos and don'ts of Internet usage, such as whether it's okay to send personal e-mail via corporate accounts. And about 30 percent monitor employee Web usage, according to SurfWatch.

Although companies have the right to monitor usage and block Internet sites, the issues aren't so black and white in the public sector. For instance, the American Civil Liberties Union and the Electronic Frontier Foundation argue that in public libraries and schools, taking away the right of users to determine which sites they can visit is tantamount to censorship.

Top-Selling Web Software

Microsoft FrontPage 98 Microsoft

Netscape Communicator Netscape

Netscape Communicator Deluxe Netscape

Web Page Construction Kit
Macmillan Software

HomePage FileMaker

Adobe PageMill Adobe

Microsoft Internet Explorer Microsoft

Netscape Communicator Professional
Netscape

HotMetal Pro SoftQuad

Director Multimedia Studio Macromedia

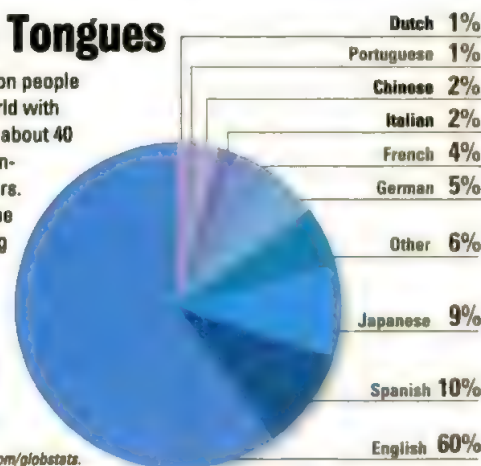
Source: ZD Market Intelligence. Data for April 1998.

China Fortune

A revolution is going on in China. Using Intel ProShare, Chinese President Jiang Zemin recently participated in a video-conference with Vice President Al Gore. The demonstration was part of Intel chairman Andy Grove's trip to China, during which he unveiled plans to invest \$50 million over the next five years in a research center. Intel projects that China (population 1.2 billion) will be the third-largest PC market by 1999.

Native Tongues

Of the 128 million people around the world with online access, about 40 percent are non-English speakers. This group is the fastest-growing segment of the online population.



Source: euromktg.com/globstats.

THIS ISSUE'S CONTRIBUTORS: Angela Hickman, Carol Levin, Sebastian Rupley, Erick Von Schweber, Don Willmott, Jae Yang.

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A digital illustration of a juggling clown standing on a stone ledge. The clown is wearing a red and white striped outfit and a jester's hat. He is juggling three balls. His reflection is visible in the water below. The background is a blue sky with clouds. Two text boxes are overlaid on the image, one on the left and one on the right.

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A JUGGLER.

AT 720 DPI YOU SEE
HE'S LOOKING AT
HIS REFLECTION.

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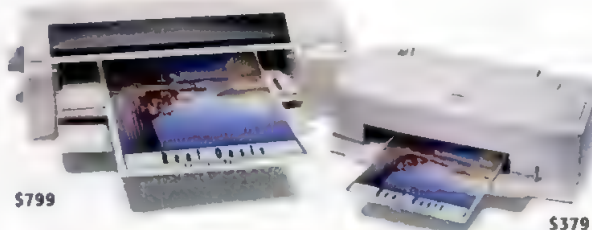
COLOR.



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THE REAL JUGGLER
IS ON THE BOTTOM.

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Letters

PERFORMANCE INCREASE

I'd like to compliment you on your quick-to-press reviews of 400-MHz PCs. I waited until the Intel release, which took place on a Wednesday, to get quotes for purchasing a new machine. I made calls on that Wednesday to various manufacturers to get configurations and prices. That evening, I went to your Web site (www.pcmag.com) and was pleased to see your reviews online. They were very complete and were a big help to me in making my choice. By Thursday, I had ordered my machine.

JACK TENISON
via the Internet

You compared a 350-MHz system with a 333-MHz system to try to measure the effect of the faster system bus and main memory. The 350-MHz PC was about 6 percent faster on the CPUmark₃₂ test and the CPU clock speed was 5.1 percent higher, meaning that the effect of the bus itself was less than 1 percent. You then note, "Applications that work with large data sets—which draw upon memory more heavily—could show an even greater benefit." Why don't you follow up on your suggestion? You could recalculate a 5MB or 10MB spreadsheet in each system (with at least 64MB of RAM) and report the difference in times. This would be the equivalent of a CPUmark₃₂ test, with any increase above 5 percent being a relatively pure measure of the potential gain from the faster bus.

JOHN R. WILSON
via the Internet

THIN AND NEW

Your report on new alternatives to centralized computing was excellent ("The New Networked Computers," May 5). It also raised a personal question for me: Would any of these new NC-based solutions be appropriate for the home arena? With three growing children, all of whom need computer access for schoolwork, the idea of one centralized server to update and manage my PC certainly appeals to me, especially if it is cost-efficient. Of course, the true litmus test would be whether or not the kids could still run the most important software of all—their games.

PETE SILER
via the Internet

You raise an excellent point about NCs in the home, a place where you will likely see NCs in the upcoming years—largely because of the factors you mentioned. For more on the future of NCs, read "PC 2001" in our issue of June 9.
—Ed.

In your May 5 articles "The New Networked Computers" and "Thin Clients, Robust



*Thanks for the
quick-to-press reviews of
400-MHz PCs.*

Servers, Husky Nets" (Net Tools), your writers both hit the mark (with wonderfully analytical detail on the various thin clients out there) and missed the mark. The advantages that Citrix WinFrame offers in a WAN environment were totally overlooked. You failed to account for Citrix's option that uses persistent object caching to cache splash screens locally on a client's hard disk. What is missing with the Citrix/NT Terminal Server thin-client model, however, is the capability to record and play back sound to and from database records located on the server. The ability to attach sound files to database records will be a minimum requirement for record storage, and two-way audio is lacking with the current offerings in the Citrix thin-client product line.

Your estimate of 75 to 100 Windows terminals on a 10-Mbps network is very low. Thin clients will pay for themselves by freeing up existing LAN or WAN bandwidth or both for future computer telephony needs and voice and video over IP.

FRANK NELSON
via the Internet

ON THE LOOKOUT

Your roundup of e-mail clients ("The Client Side of E-Mail," May 5) was useful, but your rating of excellent for Microsoft Outlook Express 4.0's address-book handling is stretching it. I have yet to find an e-mail client with a truly excellent address book. An address book would be most useful if it could be organized as a tree. Yes, you can create groups, but when composing mail you get a flat listing of every contact and group that you have entered. Otherwise, I have found Outlook Express awe-

some. It imports everything from Netscape with no problem, organizes messages in a true tree-like structure, and is easy to use.

DAG ANDERSON
via the Internet

After reading your May 5 cover story on e-mail programs, I decided to give Microsoft Outlook 98 a try, which was a big mistake. Outlook 98 tries to combine too many options, making some tasks difficult. As with Microsoft Internet Explorer, I find having access to so many folders on the C: drive gets in the way. Outlook Express's interface is much easier to use, but it doesn't have the accessories of Outlook 98. You have to use Express anyway if you want to use e-mail, and you can't work with e-mail and newsgroups at the same time. Additionally, those who receive my e-mail say they cannot use the reply function to respond to my messages.

BRIAN BATTLES
via the Internet

In your evaluation of free e-mail clients, I was surprised to note that you did not use e-mail delivery time as one of your evaluation criteria. In my experience, most free Web-based e-mail clients provide fast delivery of incoming messages (less than 5 minutes), yet one that received high marks, Net@ddress, frequently takes 2 to 24 hours to deliver messages originating outside its service to a subscriber's in-box.

KEVIN CULP
via the Internet

The article on e-mail was excellent, and your coverage was quite thorough. But you left out Pegasus Mail and stated you were doing so without giving any reason. I have an e-mail address book of over 800 entries. Eudora Pro Email 4.0 opens it instantly, CompuServe CS3 takes a second or two, and Outlook 98 requires 12 seconds to open the same list of addresses. The greatest difficulty I've had with Outlook 98 is with faxing. Outlook 98 (in the Internet Mail version) destroys Microsoft Fax, and there doesn't seem to be any way to get it back.

DAVID HOUSHOLDER
Marietta, Georgia

We did not include Pegasus Mail in our roundup because, as we mentioned in the story's introduction, the company was still in the process of testing its new version of the product at the time of the review, and the previous version had been on the market for too long a time to be considered. But keep checking our Web site (www.pcmag.com), where we will incorporate an online review of Version 3.0 of Pegasus Mail into the story. We often add to feature sto-



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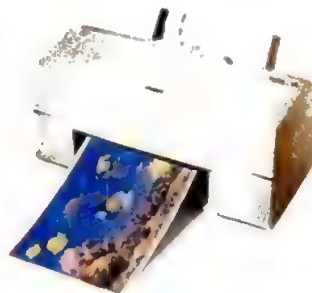
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Letters

ries with online reviews of products that come out after the original story goes to print.—Ed.

DVORAK'S MICROSOFT CRITIQUE

I usually look forward to reading John C. Dvorak's columns to see what ills in the PC industry can be blamed on Microsoft or Bill Gates. For Dvorak to blame his computer crash (however indirectly) on Gates giving speeches borders on insane ("Bill G., Come Home!," May 26). Sure, Windows 95 is not the most well-written program, but I don't wish to use OS/2 and its limited software, nor do I wish to use Windows NT and lose any DOS-based applications. Unix and Linux aren't options for me, either. I use Windows 98 and have yet to experience a single crash that was the result of the OS and not of my playing with settings. I use my PC to the fullest and I have yet to encounter any crashes with a Microsoft product. I don't know whom they were asking on the polls that state most people think Microsoft software is inferior. The only bad product I have seen from Microsoft has been Bob.

SAM DAWES
via the Internet

I work for a small company in which I'm the lone techie, and among other duties, I support 20 Windows 95 users. I've become painfully aware of the term *total cost of ownership* in the last year and a half, since we converted from a mixed DOS and Windows 3.1 shop to an all-Windows 95 shop. I couldn't agree more with Dvorak when he says, "How about getting this OS rock-solid first?" Three things come to mind: First, perhaps Mr. Gates doesn't want Windows 95 to be rock-solid. Second, my Macintosh PowerPC at home looks better to me all the time. Third, if Microsoft wants to incorporate software into the OS, maybe the company could do us a favor and subsume something

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that we cannot answer letters individually. To send submissions for PC Solutions, please see the sidebar "How to Contact Us" on the last page of that column.

Corrections and Amplifications

In our May 26 story "Network Printers," there were some inaccuracies regarding the Xerox Document Centre 230LP. The 2,000-sheet input hopper and stapler, listed as extra-cost options, are actually included in the base price of the printer. Also, the Summary of Features table erroneously indicated that Xerox does not have drivers for Windows 3.x, Windows 95, Macintosh, OS/2, and Unix. In fact, Xerox delivers drivers for all of these platforms.

In our May 5 review of Microsoft Internet Information Server (IIS) 4.0 ("Web Servers"), we incorrectly stated that IIS supports CGI. Although there is a complicated workaround that will let you use CGI, Microsoft recommends that you use ASP (Active Server Pages) instead.

In our May 5 review of ESYS Corp.'s Simeon Message Service 2.0.1 ("The Server Side of E-Mail"), IMSP should have been defined as *Internet Message Support Protocol*.

In our March 24 Net Tools sidebar "The Replication Alternative" (page 234), the URL for Network Integrity should have read www.netint.com, and the correct phone number is 800-638-5518.

In our March 24 roundup of FTP utilities ("Complete Your Net Toolbox"), we said that File Dog could not create remote directories, when in fact it can.

like Quarterdeck's CleanSweep, so Windows would have some means of cleaning itself up.

CHRIS FRENCH
Oreland, Pennsylvania

Thanks to Dvorak for sharing his chronicle of tech-support responses and software failures. It was particularly interesting in light of the fact that Windows 98 was involved. Guess what? Linux doesn't produce blue screens unless you tell it to. It doesn't perform illegal or unethical acts unless you tell it to. It doesn't require you to wipe out your system just to fix or update a device driver. And the global tech-support community is available 7 days a week, 24 hours a day to answer your questions without begging for your lunch money. Let Bill G. fiddle while Linux bugs are fixed for free and within hours. In case you're wondering about reliability, the United States Postal Service has judged Linux worthy to read the bar codes on the mail. Are you getting your mail today? Three years ago, I was asked where I wanted to go. I went to Linux and never looked back.

BRADLEY J. WILLSON
via the Internet

ANOTHER TAKE ON TCO

Jim Seymour's take on TCO (May 5) was interesting, but I think he underemphasized an important aspect of investment analysis. The only true measure of an investment's success is the return per unit invested relative to the possible returns on that investment, were it invested a different way. But many investments are constrained to meet a fixed goal. How does one evaluate an investment in computer equipment to process orders? Say you are considering two options: a new computer system (option A) versus manually processing the orders (option B). It is vital that you include only the costs of the portions of the computer system that you would not otherwise purchase for option B. If you need a desk for the computer but would also need one for option B, the desk need not and should not be included in an analysis of the worth of investing in option A. This doesn't mean you don't

have to buy the desk (you do); but it doesn't affect which option you go with.

RONALD M. COLEMAN
Sacramento, California

KIRCHNER AND RSI

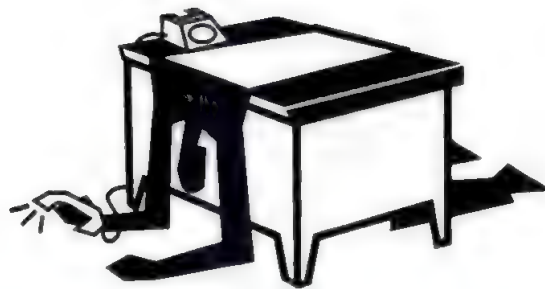
Jake Kirchner's May 5 column ("A Bit of Prevention Is Worth 2 Bytes of Cure") about repetitive stress injury (RSI) prompted me to send this note. When buying my new PC, I was really annoyed to find that most manufacturers packaged their PCs with the Microsoft mouse, an ergonomic mouse built specifically for right-handed people. I've had numbness in my left wrist and hand from using a right-handed mouse. When I've questioned stores and retailers in the past, I've gotten lame responses like, "Well, you can still use it in your left hand," which is the same thing to me as putting your left foot in your right shoe. I hope your magazine will take the time to address this issue. There are a lot of left-handed people in the world. I'm not even asking for a left-handed mouse. I'd be happy if computer retailers would just offer the option of a straight mouse like the IBM ScrollPoint Mouse or one of the Kensington models.

DONNA DE CHABERT
via the Internet

POTS VS. ISDN

Bill Howard's May 5 column "Faster Remote Connections" ends with this statement: "But ISDN will be faster than POTS only when both channels are running." Is this really true? A single-channel ISDN connection runs at 64K in either direction, and that's before any compression. With my particular single-channel ISDN setup, I regularly see over 75K of bandwidth. It seems to me that this beats POTS, which tops out at 56K, and that's only in one direction. I never thought I'd be writing about the virtues of ISDN—which my phone company is barely able to keep up and running, let alone bill me correctly for—but in this case, the praise is deserved.

STEVE CELLINI
via the Internet



DON'T LET THE DESKTOP SLOW YOU DOWN.

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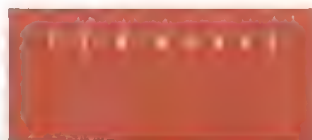
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Trends

Era of the Low-Cost PC

Sub-\$1,000 PCs are on a tear, but can the trend be sustained?

Ultracheap computers are continuing their march forward, and some market watchers are saying that their success will extend to lower prices and new categories of buyers. According to market researchers at IDC, sub-\$1,000 PCs will account for 25 percent of global desktop PC shipments by 2001, more than double their current market share of 12 percent.

One thing's for sure: Continuing price erosion could bring major shifts of power in the PC industry. "Price wars and margin pressure are already forcing market participants to re-evaluate business models and positions in the supply chain," says Kevin Hause, senior analyst at IDC. "While some PC companies and component vendors are eagerly leading the charge to lower price points, vendors with less efficient practices or misaligned strategies will be faced with significant sales and financial repercussions."

Cost-conscious customers are the big winners as sub-\$1,000 PCs proliferate. Buyers are benefiting from several technological advances, including increased integration of advanced functions onto single-chip solutions, software implementation of features that hardware subsystems have previously handled, and a slew of new low-cost microprocessors for low-cost PCs. Integration of features previously handled by separate components has been the key driving force behind the rise of the low-cost PC.

THE \$600 PC

The rise of the Internet has also fueled the trend toward low-cost consumer machines, as have falling component prices. In a recent address to the cable industry, Microsoft CEO Bill Gates said he foresaw \$600 prices for fully featured Internet-ready PCs in the near future. "Internet access is now the number-one reason cited by consumers for buying new PCs, which wasn't true at all four years ago," Intel executive vice-president Paul Otellini said recently at the PC Tech Forum, sponsored by MicroDesign Resources and *PC Magazine*.

Not everyone is bullish on sub-\$1,000 PCs. According to MicroDesign Resources vice president Linley Gwennap, "The factors that made low-cost PCs popular can easily be halted or even reversed. Since December, DRAM prices have firmed and even started to rise, as bleeding chip makers finally began to rein in production. This situation, exacerbated by Asian financial turmoil, could cause shortages as early as next year."

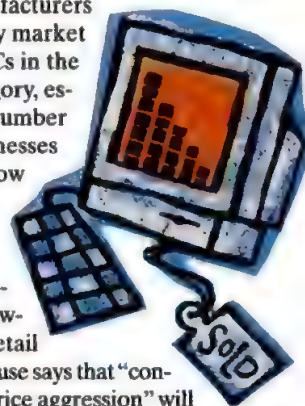
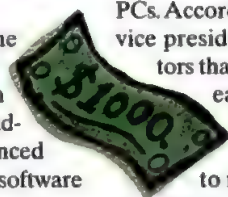
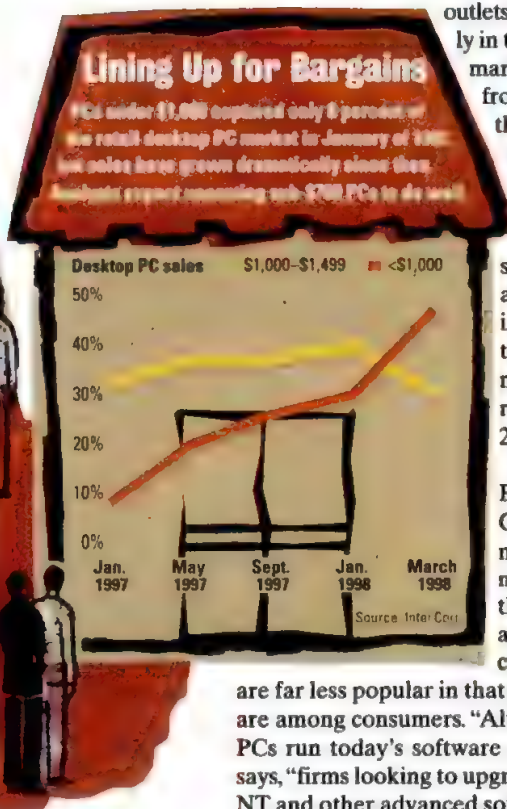
Officials at Intel have echoed that position, and they've emphasized that sales of sub-\$1,000 PCs are growing rapidly at retail

outlets but not so rapidly in terms of desktop market share. Data from Intel shows that sub-\$1,000 systems have grown to about 60 percent of retail PC sales, up from about 40 percent in March, but that their desktop market share has remained below 20 percent.

MicroDesign Resources' Gwennap also notes that businesses buy two-thirds of all PCs and that ultracheap computers

are far less popular in that arena than they are among consumers. "Although low-cost PCs run today's software adequately," he says, "firms looking to upgrade to Windows NT and other advanced software in the future might not be able to afford the limitations of a sub-\$1,000 PC." Still, many hardware manufacturers foresee a healthy market for corporate PCs in the sub-\$1,000 category, especially as the number of small businesses continues to grow at record rates.

There's no question that the numbers are coming in rosy for low-cost systems at retail outlets. IDC's Hause says that "continuing vendor price aggression" will keep the trend alive and that sub-\$1,000 PCs will make up one-third of the desktop PC market just after 2001. Aaron Goldberg, executive vice-president of ZD Market Intelligence, says that the trend toward lower prices hasn't stopped and is, in fact, proceeding in predictable steps. He foresees a boom in retail sales of \$700 PCs, commencing in 1999. Packard Bell is already selling a \$699 PC, expected to be popular among consumers who are interested primarily in Internet access. —Sebastian Rupley

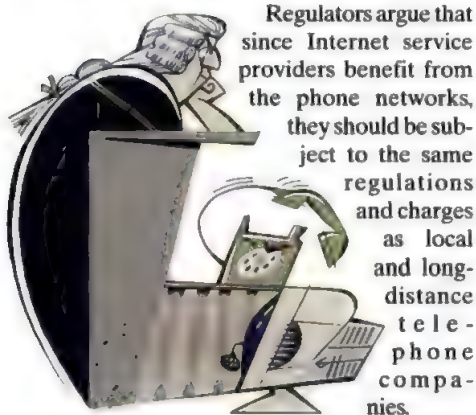


The FCC Takes On IP Telephony

Web phone calls are cheap—for now.

Although the federal government has pledged to keep its hands off Internet regulation, it's giving a lot of attention to the Internet's newest darling—voice over IP (Internet Protocol). In fact, the Federal Communications Commission has indicated that telecommunications laws should govern IP telephony services, which are now unregulated.

But many observers say regulation could strangle the Internet's potential. About 37 percent of PCs in the U.S. regularly connect to the Internet, according to ZD Market Intelligence, and market research firm IDC predicts as many as 16 million Internet telephony users by 1999.



Currently, long-distance carriers pay fees for connection into the local exchange. This money subsidizes phone service in rural and high-cost areas.

The regulatory issues become even more complex for cable companies that want to deliver IP-based telephone services. A new technology from Motorola offers 3-Mbps transfer rates for IP telephony over cable, a solution that lets a cable company bypass local and long-distance telephone companies. A cable company offering such services could be thought of as both a local and a long-distance telephone carrier, and state public-utility commissions and the FCC could regulate it as such.

Lawmakers are debating similar issues relating to Internet taxation. According to a report by a think tank called The Center on Budget and Policy Priorities, poor Americans will shoulder a higher burden of the nation's taxes if goods and services sold over the Internet are not subject to taxation. The thinking is that they can't afford the computer and Internet access charges to take advantage of the cheaper merchandise, so they'll have to pay more for the same items at retail stores.

—Angela Hickman



Hi-Res Isn't Always a Bright Idea

WHILE TESTING LCD PROJECTORS FOR A comparative evaluation to appear in our next issue, PC Magazine Labs discovered that there may be an inverse relationship between resolution and brightness. That fact should affect your selection of a new projector. In some cases, it may make good sense to maximize brightness even at the expense of resolution. Here's a preview of some of our findings.

Just as with notebook displays, the resolution for LCD projectors has risen steadily in recent years. Last year, 800-by-600 Super VGA projectors were the best available. This year, nearly half of the projectors that we've reviewed have had 1,024-by-768 XGA resolution. Some of these projectors have corresponding Super VGA models that use the same lamp and other components, allowing a comparison between the two resolutions.

Our test results show that you pay a price for higher resolution, and not just on the bill of sale. A comparison of three pairs of models shows that the Super VGA models are brighter in every instance. The Super VGA ASK LCD Impression A4+ was 11 percent brighter than its XGA counterpart, the Impression A6+; the Super VGA InFocus LP725 model was 17 percent brighter than the XGA LP735 model; and the Super VGA Epson PowerLite 5000XB model was 21 percent brighter than the XGA 7000XB model.

Why does the addition of more pixels reduce brightness? LCD projectors use polysilicon active-matrix LCD panels to create images. Unlike passive-matrix panels, which use electrodes that connect

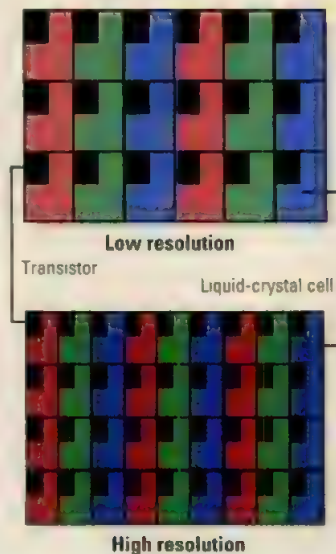
to off-panel circuitry to switch the liquid crystal cells on and off, active-matrix panels have switches in the form of tiny transistors located at each cell. The problem is that these transistors take up space on the panel and block the light. LCD panel engineers are constantly seeking ways to shrink the size of the components at each cell and thus increase the *aperture ratio*—the percentage of the cell that transmits light.

When you increase the resolution, you increase the number of transistors on the panel. A color Super VGA panel has 480,000 cells for each of three colors, or 1,440,000 cells in all. An XGA panel has 2,359,296 cells—60 percent more. Light is lost in the borders between cells, thus reducing the amount of light output for the projector. Some manufacturers put a brighter lamp in XGA models, but that generates heat and can lead to other challenges.

Keep in mind that even though projectors can scale images of higher or lower resolution, the fact

Less Is More

A low-resolution LCD projector (top) allows more light to pass through than a high-resolution design, in which more transistors block the light.



remains that you get the best-quality image when you use a signal that matches the projector's native resolution. If your source is Super VGA, you actually lose image quality using an XGA projector. Furthermore, Super VGA is generally sufficient for most presentation graphics. If you need more resolution, you likely have too much information on the screen.

So if you can use an 800-by-600 source signal most of the time, a Super VGA projector is likely to give you a better image with more light at a lower cost than a corresponding XGA projector. And that's a bright idea.—Alfred Poor

SunLabs' Coming Attractions

R & D projects look three to five years into the future of the Web.

Since 1990, engineers at Sun Microsystems Labs have been working on projects with "high risk and high uncertainty," says director Bert Sutherland. Looking three to five years ahead, his team of 120 researchers—located in Boston, New York, and Mountain View, California—explore ideas outside the mainstream. One fruit of their labors is Java. SunLabs recently demonstrated some of its works in progress, from a hand-held ATM to a tiny Java ring that can exchange business cards. "There's a real serious PIN problem on the Web," says Rinaldo Di Giorgio, a staff engineer in the Digital Economy group. But if you store a personal profile on a Java-based smart card (a credit card-size device with a tiny embedded microprocessor), multiple passwords can be a thing of the past. And taking Java's platform portability to the extreme, SunLabs has built applications that run on the Java Ring, which can store and transfer business cards or digital cash to other Java Rings over a tiny 115-Kbps ring reader.

Over at SunLabs' Boston Center for Net-



KNUCKLETOP COMPUTING: The jewel of this ring is the iButton, which runs a Java Virtual Machine.

working, director Phil Rosenzweig is trying to unclog network traffic jams, which can slow to a snail's pace access to the Internet and corporate networks. His team has come up with a version of Internet multicasting technology called Reliable Multicast Service. It's a data-distribution model that alleviates network stress by delivering only one copy of a live

video segment, for example, to thousands of clients that tune in to the broadcast.

No research lab is complete without a group devoted to speech recognition and speech synthesis. Nicole Yankelovich, principal investigator in SunLabs' speech-applications group, has demonstrated a system that answers your telephone calls and reads your calendar entries, e-mail, and stock quotes to you.

Meanwhile, in SunLabs' Conceptual Indexing Project, researchers are working to improve Web searches with a

technology that's pretty smart about word associations. A key component is a lexicon that connects concepts in your request with concepts in the indexed material. The result: A search for "storm damage" considers "destruction due to hurricane" a fairly good match. When you use this technique, says Bill Woods, principal scientist on the project, "nuggets of wisdom that defy systematic classification in conventional databases can be automatically organized and efficiently searched."—Carol Levin

Why Wear a Chip?

Open a locked door.
Log on to a computer.
Store digital money,
medical information,
driver's license,
passport.
Make Internet
transactions.

JAKE KIRCHNER

Do PCs Have to Be Ugly?

The personal computer industry is innovative and exciting. It's also quite in style these days, with its leaders hobnobbing in entertainment and political circles. But let's face it: The product of the PC business—the typical personal computer—has all the fashion sense and design pizzazz of a hacksaw. I know the PC is only a tool, but even tools can benefit from good design.

Have you ever wondered why design is so vital to the success of any automobile—in theory a rather utilitarian product—but so inconsequential to the personal computer? You could make a PC out of dirty cardboard and it would sell if it had the right specs and a low-enough price.

Still, there are those in the business who believe that a PC should do more than deliver software and information, that it matters how the machine fits our hands and graces our desktops. Two years ago we gave a *PC Magazine* Technical Excellence Award to the Acer Aspire desktop. Among its key attributes, the Aspire at that time sported a case with stylish decorative holes and was available in black and emerald green. Not the PC equivalent of the Dodge Viper, but still a fashion statement. The Aspire has been a successful product for Acer but not because of its design, and that flashy green color is long gone.

Oh, there are always oddball computing products that stand out for their design. The Panda Project, for instance, has a PC dubbed Rock City—a 10-inch black aluminum cube that sits balanced on one corner. This "artistic alternative to conventional systems" (in



the company's parlance) is a stunner. The very latest personal computer with more than a dash of brio is the iMac, from Apple Computer, an all-in-one design in translucent aquamarine and white.

Apple's interim CEO, Steve Jobs, argues that fashion sells in the PC world, but it's hard to tell by his experience. When he left Apple in 1985 to start up NeXT, the new firm's first computer was a visual delight, but it was also high-priced and technically quirky. It quickly went the way of the Edsel. The iMac is a more on-target product and gives any Mac enthusiast a great reason to buy a new or second machine. But with a price of \$1,299, a 33-Kbps modem, and no floppy disk drive, the iMac hasn't a chance of grabbing market share from the lower-cost and more feature-rich PCs flooding the market.

Today it's all about price and specs. High-tech is hip enough to sell on its technical merits alone. Just about every household now boasts rack-mounted stereo components and black monitor-style televisions. And a plain-Jane beige PC is perfectly acceptable. Anything with a little design élan sticks out like a Volkswagen Beetle with fins.

I for one would like to see the PC makers move beyond the New York look—you know, the sense that anything stylish has to be black—and take up the design challenge issued by the Rock City and the iMac. Somehow there has to be room in this market for the PC equivalent of the Porsche Boxter. I'm not sure I'd buy a flashier PC, but I'd sure take it for a test drive around my office.

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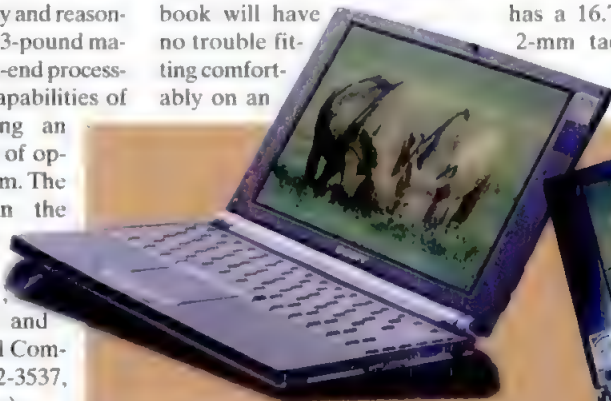
NOTEBOOKS

Notebooks in Miniature

In the ever-shrinking world of portable PCs, the mini-notebook is finally coming into its own. Business professionals who value the added portability and reasonable pricing of sub-3-pound machines over the high-end processing and graphics capabilities of laptops are finding an increasing number of options to choose from. The latest products in the pipeline are from Sony Electronics (888-315-7669, www.sony.com/pc) and Panasonic Personal Computer Co. (800-662-3537, www.panasonic.com).

The revolutionary Sony VAIO 505G Super Slim Notebook (\$2,000 street) is the first 3-pound mini-notebook to offer a 10-inch display and a 200-MHz processor. The notebook is aimed squarely at the mobile professional to whom weight and size are more important considerations than data and content creation.

The dimensions of this system are truly astounding: Just 10.2 by 0.94 by 8.2 inches and weighing a mere 2.9 pounds, this notebook will have no trouble fitting comfortably on an

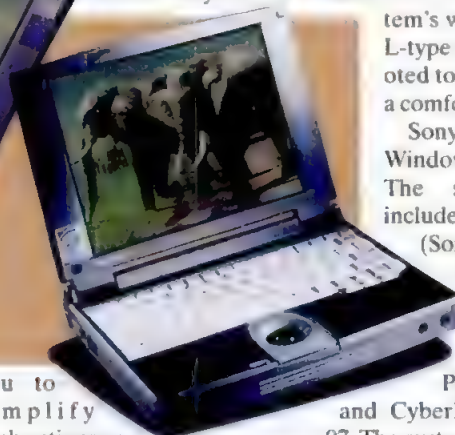


THE MINUTEMAN: THE SONY AND PANASONIC Systems from Sony (left) and Panasonic.

airplane's economy-class tray table. The 505G is equipped with a 200-MHz mobile Pentium CPU with MMX Technology, 32MB of SDRAM (expandable to 64MB), a 2.1GB fixed hard disk, and a 10.4-inch SVGA active matrix LCD. There's also support for MPEG-1 Digital

Video Playback. Included is a K56flex modem (software-upgradable to the V.90 standard) that has a built-in full-duplex speakerphone. Both an external floppy disk drive and a port replicator are bundled with the notebook.

The almost full-size keyboard has a 16.7-mm key pitch and 2-mm tactile keystroke. The programmable Power Keys allow



you to simplify such actions as collecting e-mail or downloading Web pages to a single touch. The system's integrated digital touch pad supports pen input; a slim writing stylus is conveniently included with the system.

REGAP PC Magazine last reviewed notebooks in our issue of January 20, 1998. In the subnotebook category, the IBM ThinkPad 560X was awarded Editors' Choice.

The standard S-type battery provides 2.5 to 3 hours of battery life. The extended life L-type battery—a \$300 option that replaces the S-type battery—doubles this capacity but adds about 0.4 pound to the system's weight as well. The L-type battery can be pivoted to give the keyboard a comfortable incline.

Sony plans to preinstall Windows 98 on the 505G. The software bundle includes VAIO Space II (Sony's own navigation interface for accessing applications), Microsoft Works, Adobe Photo-Deluxe 2.0,

and CyberMedia's First Aid 97. The system also comes with 90 days of free Internet access (2 hours per day for up to 50 hours total).

Targeting the corporate market is the **Panasonic Toughbook 31** (\$2,000 street). The Toughbook 31 has a 120-MHz Pentium MMX processor, 16MB of EDO RAM (expandable to 80MB), a 1.6GB hard disk, an installed external RAM cache of 256K, and an 8.4-inch active matrix LCD screen.

Weighing only 2.2 pounds, the Toughbook 31 measures 6.7 by 1.4 by 8.8 inches. The small-size keyboard is complemented by a trackball. In order to extend battery life, the unit does not use a CPU fan; instead, the Toughbook 31 utilizes Matsushita's proprietary heat-dispersion design, using graphite tape wrapped around the CPU. The regular battery has about a 2- to 4-hour life; a spare that provides 8 extra hours is available for \$200 (street). Microsoft Windows 95 is preinstalled on the notebook; there are no software bundles available at this time.

—Sharon Nash

Multimedia Portability

Conventional wisdom would have it that purchasing a portable computer inevitably means inadequate graphics and keyboard capabilities. Changing that perception is MetroBook Computer Corp. (888-829-5300, www.metrobook.com). Unique in the portable market is the **MetroBook DT** (pricing starts at \$4,500 street). The system is notable for a 15.1-inch XGA TFT screen with zero radiation and a comfortable, full-size keyboard complete with a standard numeric keypad that number crunchers will appreciate.

The large screen lets you give presentations complete with multimedia trimmings directly from your laptop, eliminating the need to tether your laptop to an external monitor. Weighing in at 9.9 pounds and measuring 14 by 10.8 by 1.9 inches, this machine's considerable weight means that frequent travelers wouldn't want to use this system. But



the MetroBook DT is ideal for those hopping from desk to conference room and back again.

Inside the chassis, the MetroBook DT is available with either a 233-MHz or 266-MHz Pentium MMX processor and supports up to 128MB of RAM (32MB come standard). The system is also equipped with a 4GB removable hard disk, 512K of cache, a 20X CD-ROM drive and 3.5-disk drive, an Iomega Zip Drive, a K56flex fax modem, and a touch pad. The multimedia attributes of the MetroBook DT include a 16-bit sound processor, built-in stereo speakers, a graphics subsystem with 4MB of EDO RAM, a 3-D audio effects processor, a microphone, a Zoomed video port, an NTSC/PAL video-out port, and an RCA jack for video input. It also includes two USB ports and one each of serial, parallel, and IrDA ports.—SN

IMAGE EDITING

Photoshop's Imaging Magic

Ever since its initial release, Adobe Photoshop has set the standard for professional-level image-editing software. The new **Adobe Photoshop 5.0** (\$650 street) continues that tradition, once again raising the bar for the standard against which other image-editing packages will be judged. Adobe Systems (800-492-3623, www.adobe.com) makes Photoshop 5.0 an indispensable upgrade by adding a host of tools and improving color management.

The biggest news with this release is that Adobe has finally added some industry-standard tools that Photoshop had been lacking up to now—and for which users have been clamoring.

Photoshop now supports greater text-manipulation capabilities via its vastly improved text tools. You can create vertical text, perform character-level formatting—including tracking, kerning, leading, and baseline offsetting—and mix font styles and sizes all within a single text block. Since text is created in separate layers, it remains fully editable at all times, giving you greater control over text elements.

Arguably the most useful addition to Photoshop is the Magnet-

ic Lasso, a tool that combines the intuitiveness of the Magic Wand with the control of the traditional lasso. Freehand selections snap to lines in the image based on color contrasts, making the process of

option, you can draw a cube, sphere, or cylinder around an object. Photoshop simulates it as a 3-D object, based on its center point, and lets you rotate the object slightly. Movement is limited by the amount of image information, but this provides an interesting way to make small changes to an object's orientation within an image.

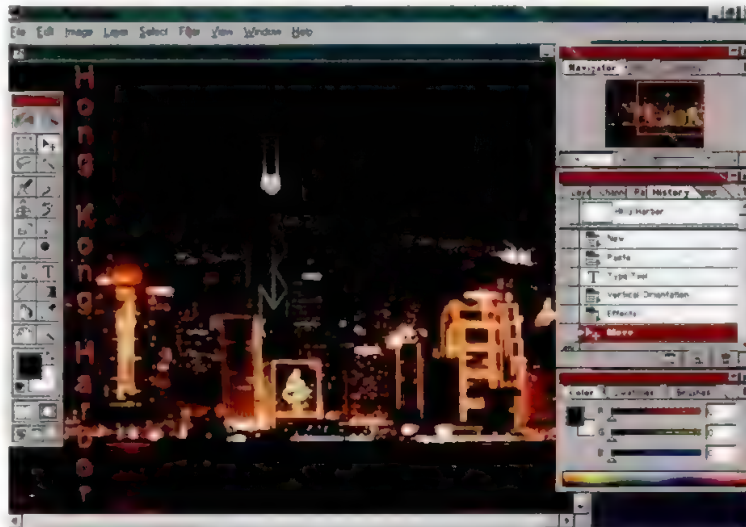


IMAGE MAKER: In addition to vertical text, Photoshop 5.0 adds a History Palette for tracking your changes to an image.

selecting objects easier. The pen also includes a magnetic option that functions in the same way.

An interesting new feature is the ability to manipulate objects as if they were three dimensional. By using the 3-D transform

The ability to automate tasks has also been vastly improved. The Actions Palette lets you record more program operations than ever before. Working with layers is now aided by the Layer Effects feature, which automati-

cally regenerates the effects that have been placed on a layer each time that layer is edited; this means that any future edits to a layer, such as brush strokes, may be affected by the effects that were earlier placed on that layer. Adobe has also added support for Automation Plug-Ins, which represent automated tasks and actions. Maintaining consistency in an image is easier too, as a Global angle can now be defined, causing all light and shadow effects to be applied in a uniform manner.

The new History Palette provides a chronological list of the past 100 actions you've made. In a single click, you can return to any chosen step, instantly undoing multiple actions. You also have the ability to step backwards and forwards through the actions. Using the History Brush tool, you can select a certain step in your drawing and lock everything that was created up to that point. You can then paint the selected prior state back on to portions of the image.

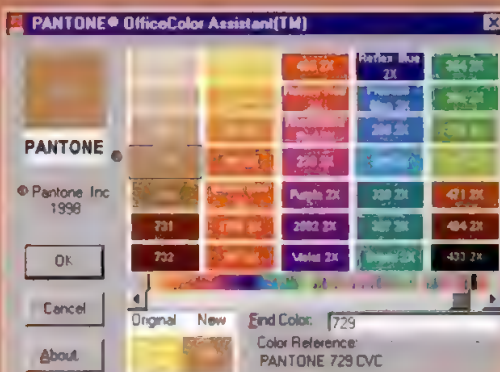
Color control has also been greatly improved. The new Spot Channels feature lets you specify premixed inks or varnishes instead of, or in addition to, Process Color. The Color Samplers work much like the eye dropper but let you sample up to four locations at once—giving you the usual information about each selected color in the Info palette simultaneously.

To ensure that an image will look the same when printed or opened on different hardware, Photoshop 5.0 supports ICC-compatible tools, such as Microsoft ICM, as well as the color management engine that appeared in earlier versions. In addition, Photoshop now supports Standard RGB (sRGB), an emerging color management system that Microsoft plans to include in Windows 98 and Windows NT 5.0.—*Matthew Graven*

Bringing Out Your Image's True Colors

Pantone has long been a leader in the development of color management software (888-726-8663, www.pantone.com). The company has expanded its offerings to include **Pantone OfficeColor Assistant** (\$25 street), a Microsoft Office 97 add-on that integrates into Office's drawing tools. OfficeColor Assistant gives you access to Pantone's 1,012 Pantone Matching System colors while you're working with an object, such as a company logo, in a document. This ensures that your images reflect the appropriate colors both on-screen and in your printed output.

Also available is Pantone Personal Color Calibrator (P2C2), which helps you to set your monitor's display colors to produce accurate colors (\$50 street). You simply answer a series of questions—mostly choosing colors that blend into background colors—and P2C2 will create a color profile for your system that helps your monitor produce ideal color output.—*MG*



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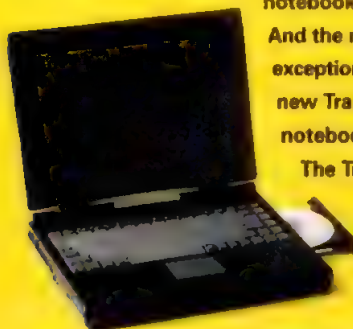
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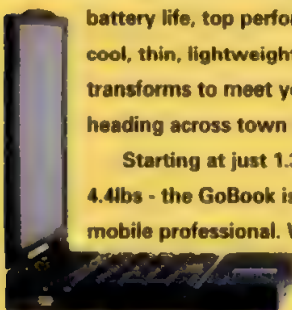
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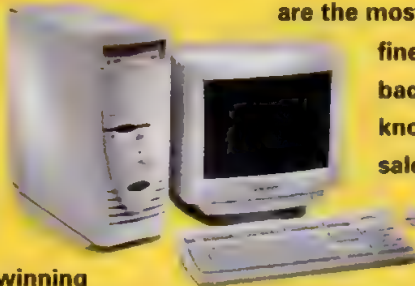
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Dual Pentium® II processor capable

Fully Integrated

- Ultra-wide SCSI
- 10/100 network adapter
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- I₂O® Ready scalable
RAID solution

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array without shutting down
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hard drive redundancy
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N+1 Redundant Hot-Swap Power Supplies

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- 2+1 (3 total) 360 Watt each
power supply option



Take away the catchy headline. Forget the cute bovine mascot. Ignore the jingle that sticks in your head and look at the product. Look at how it's built, what it costs and how it's supported. That's what really matters, and since 1985 that's all we've focused on. Perhaps that's why Micron was just ranked first among all PC vendors in customer satisfaction by *PC Week* readers. We invite you to compare the numbers for yourself because a better server is the only thing you should be buying.

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THE NEW NETFRAME 3100 SETS A NEW STANDARD FOR ENTRY-LEVEL PC SERVERS.

While fully loaded systems aren't always needed at first, the ability for a server to grow as your business grows is critical. The new NetFRAME® 3100 provides that upgrade path. It incorporates mid-range features like hot-swap hard drives, convenient remote management technology and a highly



integrated motherboard. It also features the 440BX chip set — Intel's latest chip set technology supporting 100MHz front side bus and 100MHz SDRAM. Combined with the fastest processors available, this server offers networked businesses the performance of a dependable mid-range server at an entry-level price.

NetFRAME LV2000 Small Business Server Edition.

- 266MHz Intel Pentium II processor
- Dual processor capable
- 64MB ECC SDRAM
- 4GB Ultra-Wide SCSI-3 hard drive
- Microsoft® Small Business Server 4.0 (10 user license)
- NOS support (3 first-year incident resolutions), 7x24
- 512KB integrated L2 ECC cache
- 5 expansion slots: 4 PCI, 1 ISA
- Integrated Adaptec PCI Ultra-Wide SCSI-3 controller
- Intel EtherExpress Pro 100 network adapter
- 56Kbps x2 US Robotics modem*
- Upgradable to 36GB storage
- Seagate 4/8GB SCSI tape backup drive
- 32X EIDE CD-ROM drive
- Intel LANDesk® Server Manager
- Dedicated server technical support, 7x24
- 5-year/3-year Micron Power™ limited warranty
- 1-year next-business-day on-site service**

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NetFRAME 3100

- 333MHz Intel Pentium II processor
- Dual processor capable
- 64MB ECC 100MHz SDRAM
- 4GB Ultra-Wide SCSI-3 hard drive
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- NOS support (3 first-year incident resolutions), 7x24
- Intel 440BX PCI chip set
- 512KB integrated L2 ECC cache
- 100MHz front side Bus
- Integrated Symbios Ultra-Wide SCSI-3 dual channel controller
- RAID capable
- 5 expansion slots: 3 PCI, 1 ISA, 1 shared PCI/ISA
- 8 drive bays: 1 external 3.5", 2 external 5.25"
- 5 hot-swap hard drive bays
- 32X EIDE CD-ROM drive
- Integrated SVGA graphics (2MB)
- Integrated Intel 10/100 Ethernet
- Intel LANDesk Server Manager
- Dedicated server technical support, 7x24
- 5-year/3-year Micron Power limited warranty
- 1-year next-business-day on-site service**

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\$129/mo
Business Lease

NetFRAME MV5000

- 266MHz Intel Pentium II processor
- Dual processor capable
- 64MB ECC SDRAM
- 4GB Ultra-Wide SCSI-3 hard drive
- Microsoft Windows NT Server 4.0 (10 user license)
- NOS support (3 first-year incident resolutions), 7x24
- 512KB integrated L2 ECC cache
- Memory: ECC, EDO or SDRAM option
- 9 expansion slots: 6 PCI, 2 ISA, 1 shared ISA/PCI
- Dual Integrated Symbios Ultra-Wide SCSI-3 controller, 1 narrow
- Intel EtherExpress Pro 100 network adapter
- 32X EIDE CD-ROM drive
- RAID capable
- 5 internal, hot-pluggable, hard drive array bays (upgradable to 10)
- One 360-watt hot-pluggable power supply standard (upgradable to 3 for added redundancy)
- Intel LANDesk Server Manager
- Dedicated server technical support, 7x24
- 5-year/3-year Micron Power limited warranty
- 1-year next-business-day on-site service**

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Thinnovation. You already know that Mitsubishi practically wrote the book on award-winning CRT monitor design. Now we've combined dazzling image quality, higher contrast and extraordinary brightness in a fraction of the size. Featuring a distortion-free TFT active matrix screen, increased color clarity and crystal-clear, flicker-free images, Mitsubishi's 14" and 15" LCD models (LCD40 and LCD50) are ideally suited for any application where space is at a premium. In fact, the ultra-thin LCD monitors use nearly 90% less desktop space than a standard CRT display. Mitsubishi's LCD monitors offer a true display solution for anyone looking for high-performance in a compact, lightweight design. Contact Mitsubishi Electronics today and we'll send you the condensed version of our latest monitor success story.



USA: 1-800-843-2515 • Canada: 1-800-387-9630 • www.mitsubishi-display.com/pmg/
QWIKFAX: 1-800-937-2094 (Document #1015)



Mitsubishi LCD	Model	Model
Viewable size	14.0"	15.0"
Max Resolution	1024x768/1152x864	1024x768/1152x864
Refresh	75	75/85/90
Dimensions (HxWxD)	9.6x9.6x5.7	10.6x9.6x5.7
Brightness	180 cd/m ²	200 cd/m ²
Viewing Angle	H: ±70°, V: +60°, -50°	H: ±70°, V: +70°, -50°
Panel	TFT Active Matrix	TFT Active Matrix

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Trends Peripherals

MONITORS

Price Drop for LCD Monitors

For demanding high-end PC users, LCD monitors are the best option for sharp, clear, flicker-free displays. Although they're still expensive, prices continue to decline, and more customers are starting to consider them a practical alternative to bulky CRTs.

NEC Technologies (800-632-4636, www.nec.com) has unveiled

RECAP In our issue of September 9, 1997, we reviewed five LCD monitors in First Looks. We awarded our Editors' Choice to the NEC MultiSync LCD400.

two new active-matrix TFT entries into this market. Both the 15-inch **NEC MultiSync LCD1510** (\$1,800 street) and the 15-inch **NEC MultiSync LCD1510V** (\$1,500 street) are capable of 1,024-by-768 resolution and refresh rates of up to 75 Hz. Each of these monitors features NEC's XtraView technology, which allows for 160-degree wide-angle viewing.

Another vendor to offer a new 15-inch

active-matrix LCD monitor is EIZO Nanao Technologies (800-800-5202, www.eizo.com). Built using EIZO's D³ technology, the 15-inch **Eizo Nanao FlexScan L34** (\$2,000 street) includes digital signal processing for auto-

matic contrast adjustment and is capable of 1,024-by-768 resolution with a refresh rate of up to 75 Hz. D³ technology consists of a special chip that expands

the panel's color capability to 16 million colors. The FlexScan supports a wide viewing angle of 140 degrees horizontal and 110 degrees vertical. EIZO's One Touch Auto Adjustment feature can automatically locate the screen's optimal position and size. —Stephanie Lindbaum



BLACK AND SLIM:
Dazzling LCD screens for EIZO (left) and NEC.

PRINTERS

Personal Fotomats

If you've ever captured high-quality images with a scanner or digital camera but found yourself disappointed with the output of your color ink jet, it's time to try a personal photo printer. The latest of-

ferings use high-quality inks and special paper stock to ensure that the quality of the original image doesn't degrade as it makes its way to paper.

From Canon Computer Systems (800-652-2666, www.ccsi.canon.com) comes the **Canon BJC-7004 Photo**. Using seven colors of ink, the BJC-7004 (\$350 street) can print at 1,200-by-600 dots per inch (dpi) resolution on a large variety of paper sizes. Featuring Canon's proprietary P-POP (Plain Paper Optimized Printing) technology, this

printer is designed to enhance water resistance, eliminate feathering and bleeding between colors, and produce sharper text. Print speed for letter-size paper is rated at 3.5

pages per minute (ppm) in color and 5 ppm in monochrome. The printer is compatible with all Microsoft Windows platforms and comes bundled with Canon Creative 3, a photo-editing package.

ALPS Electric (800-825-2577, www.alpsusa.com) is also taking advantage of a proprietary technology. At \$550 street, the **ALPS MD-1300** uses the company's Micro Dry ink technology. Unlike standard ink jets, Micro Dry generates dry, waterproof prints that look as flat as a photo. Targeted at digital photographers and graphic artists, the MD-1300 prints 3 to 5 ppm in color and generates 600-by-600 dpi on either standard or photo paper; it can print out in continuous-tone color on DISA paper. Black and white images print out at 5 to 12 ppm in 1,200-by-600-dpi resolution. The unit is compatible with Microsoft Windows 3.1, 95, and NT, and bundles ALPS's Color Matching Method utility for color correction and Adobe PhotoDeluxe 2.0 for image editing.

The **Newcom Personal Photo Developer** is a hardware and software kit designed to fit into your PC's chassis (800-563-9266, www.newcominc.com). The Personal Photo Developer makes it easy to create 3.5-by-5-inch prints of any JPEG, PCX, GIF, TIFF, or TGA photo file. The internal version, which fits

into a 5.25-inch drive bay, costs \$219; an external parallel-port version costs \$249.

With the bundled viewing and editing software, users can process electronic images in under 3 minutes at a resolution of 160 pixels per inch (equivalent to over 2,500 dpi). The drive itself features *cylithographic* technology, which uses pressure rollers inside the drive to crush light-sensitive, color-releasing microcapsules embedded in a special roll of paper film. To help you get started, NewCom includes a free 20-exposure cartridge of cylithographic film with the drive. —Roderick A. Beltran



SAY "CHEESE":
New photo printers from Canon, Newcom, and ALPS.



Sleeping Giant Awakens

With the introduction of the ViRGE family of chips, graphics giant S3 was one of the first to develop an integrated 2-D and 3-D graphics accelerator. Faster chip sets from 3Dfx, ATI, nVidia, and Rendition have since leapfrogged ViRGE, however, and S3's sales plummeted. The company is back in the game with its new Savage3D chip, which S3 claims will beat current competitors in 3-D rendering speed and quality. Expect the Savage3D to start appearing on graphics cards this fall.

—Jamie M. Bsaies

E-MAIL MANAGEMENT

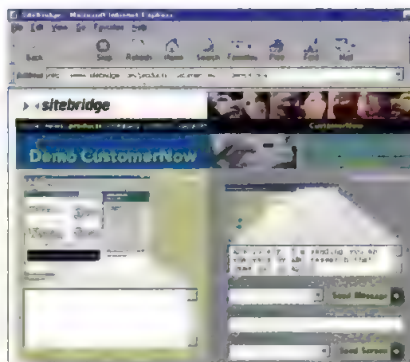
How Can We Help You?

Making a personal connection with your customers and business associates is always a good way to differentiate yourself from the cold, impersonal competition. But drowning in e-mail—whether they're queries from your Web site or messages directed at you—often makes it difficult to do more than just send an automated response. Helping you to manage your e-mail are Kana Communications (650-812-0406, www.kana.com) and nsoftware (www.nsoftware.com), which address the enterprise and personal levels, respectively. SiteBridge Corp.

(212-645-8700, ext. 212, www.sitebridge.com) also has a package targeted at enterprises.

Version 2.0 of **Kana Customer Messaging System** (a server for 10 concurrent users costs \$79,500) is a complete enterprise-class e-mail management application that enables businesses to manage, respond to, and capitalize on customer e-mail.

Kana CMS can help improve customer service by giving you the means to provide quick, personal,



BUSINESS CHAT: CustomerNow is designed to be a customer call center for the Web.

and consistent e-mail responses as well as the ability to capitalize on customer e-mail with message content analysis. You can also reduce your overhead costs if you consider Kana CMS as an alternative to phone-based support.

This package's Automation Engine is designed to trigger responses to e-mail messages based on their content, history, and size. The system can send an automated response to the customer or automatically suggest a response to a customer service representative.

SiteBridge Corp.'s **CustomerNow** is designed to be a customer call center for the Web. This software enables real-time visual col-

laboration and chat between a live customer service representative and an online customer, making it best suited for environments where customers require an immediate response to queries.

CustomerNow starts at \$30,000 per server; each server can handle five customer-service representative seats.

Repetitive e-mail tasks for those using Microsoft Exchange/Outlook can be simplified using nsoftware's **Exchange Templates** (\$50 per user). With this package, rather than creating similar messages again and again—or cutting and pasting from other documents—you can simply select a template and create a new reply, forward a message with accompanying text, or quote preset text into a message you are creating.

Exchange Templates lets you insert message properties and dynamically generated text, including a sender's name and the subject. Templates are stored as messages in Outlook or Exchange folders and can be exported as either plain text or rich text format messages. The program also supports Outlook's Automatic Rule interface, for automatically replying to incoming messages.—Doug Beizer

JAVA DEVELOPMENT

Better, Stronger, Faster

For many Java developers, speed is of the essence. The popularity of Java continues to generate plenty of new products, including tools to make Java code run faster. These efforts continue to bring Sun Microsystems' programming language into the mainstream for developers.

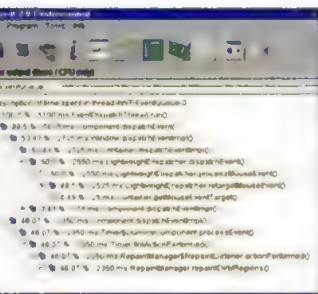
Java versions of native code

crossed Windows 95 and NT and Sun Solaris 2.4 or later.

The program lets you track the CPU and memory usage for any Java component, whether or not source code is available. There's full support for viewing Java threads and the details of Java's garbage-collection mechanism. A variety of graphs and reports, including HTML, are available to show you exactly what's happening in your Java code.

Another product aimed at providing speedier performance is **TurboJ 1.1**, from the Open Group Research Institute (617-621-8700, www.opengroup.org/RI). Priced at \$200 for the Linux version, this package can accelerate Java for Linux and HP-UX systems by compiling Java byte codes into faster 'native' code. On many Java platforms, Java code is compiled at runtime (JIT), or just-in-time compilation). For Unix users, TurboJ adopts a similar strategy in that compilation occurs while a Java executable is downloaded over the network and compiled on the fly.

—Richard V. Dragan



SPEED IT UP: OptimizeIt 2.0 helps your Java code run faster.

applications can sometimes run unexpectedly slowly. **OptimizeIt 2.0 Professional**, available for \$389 from Intuitive Systems (408-245-8540, www.optimizeit.com), is a profiling tool that can make your Java code run faster and more efficiently. Written in Java itself, OptimizeIt runs on both Mi-

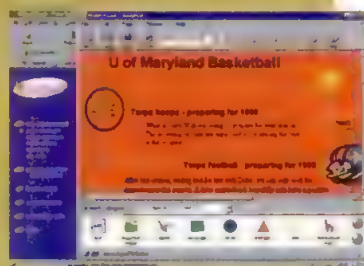
Stake Out Your Homestead

Are you still shying away from building a Web page because the tools are too intimidating or expensive? Now you can build and post a Web page in literally minutes using **Homestead Technologies'** new free service (650-306-0670, www.homestead.com). Available at the company's Web site, the service requires no special software, plug-ins, uploads, or programming knowledge in order to accomplish your goal of creating a Web page.

First, you'll need to set up a free account with Homestead. Then, using the Homestead Editor you drop different elements into your page using a simple toolbar. Elements include clip art, animations, links, and other features.

Homestead also makes it possible for a number of people to build a site together. An individual can start a Homestead page, then invite others to help build and maintain the site. You can choose to keep your site private or publish it to the publicly accessible directory.

Because all files are stored on Homestead's servers, users can create and edit their sites from any PC using Netscape Navigator 3.0 or later or Microsoft Internet Explorer 4.0.—DB



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TEAMWARE

Web Collaboration

The collaboration tools found in groupware packages are useful for any project. But for non-centralized groups and small companies with no IS support, a full groupware solution is not an option. Filling the gap are the latest Web-based teamware collaboration tools that can be rented for a low monthly fee. That way, groups can use these tools neither for a single project with an outside partner nor as a low-maintenance alternative to groupware.

Instinctive Technology (617-497-6300, www.instinctive.com) is leading the second generation of teamware products with **eRoom 2.0** (\$99 per user for 50 users). The user-administered client-server software lets you create a virtual room for each project that resides on the server. These rooms contain the resources that let you post and share documents, run discussions, and conduct surveys. eRoom even permits you to drag and drop files between the virtual rooms and your desktop, making it even easier to share files.

The new version increases scalability over the original by enabling you to host hundreds of project rooms from a single eRoom server. To help administer all those rooms, you can now manage eRoom via your Windows NT directory. Also introduced in this version are fully threaded discussions and the ability to integrate documents directly into those discussions; one-click document version tracking, which lets you view a complete history of who altered a document and when; and content indexing for all the resources in a room, allowing you to search for specific information within documents and discussions.

ments and discussions.

Changepoint International Corp. produced one of the first teamware products on the scene,

BETTING TOGETHER: eRoom 2.0 leads the next generation of teamware software.

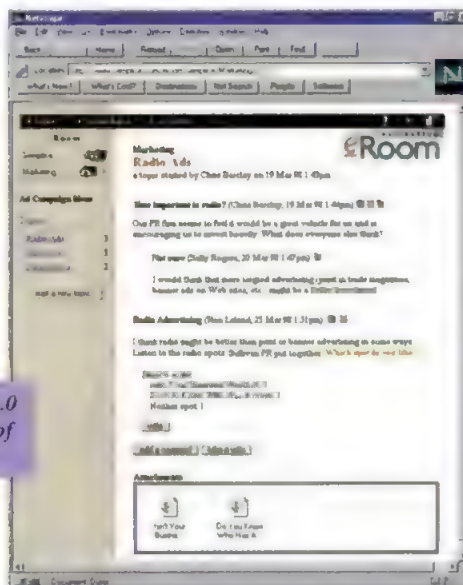
involv.net. The latest version, **involv Teamspace** (800-263-7189, www.involv.net), refines and expands on the original, which offered the rental of individual applications for projects. Instead, Teamspace (\$12.95 per user per month) provides a centralized Web workspace based on a group home page that gives access to a full spectrum of collaboration tools for one price.

Teamspace's interface is more unified than that of its predecessor. The workspace is organized around tabbed binders that permit easier navigation. Each team member now receives a customizable home page that

shows all the projects being worked on. In turn, every project has its own page that represents the task as a threaded workflow diagram. All the tools are in one place, and you use them when appropriate as you go along. For example, a discussion thread about a project timetable can be followed up with a task-assignment application to set the dates.

Changepoint is also introducing a new version of its client-server product, **involv Intranet 3.0** (\$5,000 per Lotus Domino server, plus \$40 to \$90 per user). Although involv Intranet has a server component, the software is managed exclusively by users, thus reducing the IS burden. Expanding on the functionality offered by the Teamspace product, involv Intranet gives you speedier access to your information. New in Version 3.0 is a fully customizable interface and a day-at-a-glance view that shows you just the groups that changed since you last logged on.

—Michael N. Rusignuolo



DOCUMENT MANAGEMENT

The Web Filing Cabinet

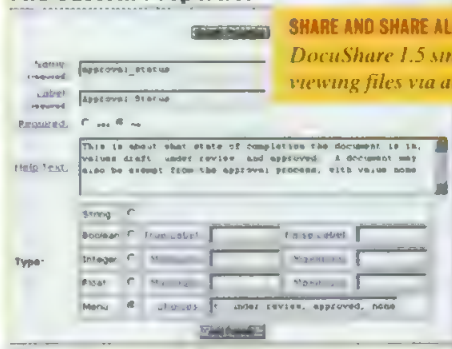
Getting an important document distributed to your entire corporation can be difficult: Your art department uses Macs, and a branch office doesn't use Microsoft Word. Two client-server products can help by providing a way to create browser-accessible versions of your files that anyone on your intranet can read.

Net-It Software's (888-638-4886, www.net-it.com) **Net-It Central 2.5** (\$4,995 per server) uses proprietary Java-based jDoc technology to convert a laundry list of different file types for viewing on the Web. You can also download the original file in the original format with a single click.

One advantage is that Net-It Central 2.5 can preserve any font in a document—an important feature if you rely on in-house corporate fonts, for example. The software also automatically converts

and preserves hyperlinks in documents, even if the program that created the document can't. The new version can use Microsoft Windows NT Server Manager for remote control and administration and can be deployed on Win-

File Custom Properties



SHARE AND SHARE ALIKE:
DocuShare 1.5 simplifies viewing files via an intranet.

dows 95 and NT client machines as a standard Windows application instead of a Web-only program.

If you need to share more than text documents, Xerox Corp.'s **DocuShare 1.5** (\$695 for single server and 25 clients) lets you post calendars, graphics, and audio-visual files and make annotations to files (800-428-2995, www.xerox.com).

New to this version are such welcome enhancements as the ability to access your documents via a Web browser. This allows you to print and view a file without having the original application installed on your machine. DocuShare also lets

you assign searchable properties to each document in order to build advanced search queries. The product features a new activity log that lets you track user activity, and for extra piece of mind, Version 1.5 includes SSL support. —MNR

REGAP PC Magazine tested seven teamware packages in our February 10, 1998 issue. We awarded Editors' Choice to HotOffice Virtual Office Service.

STATISTICA

STATISTICA (automatically configures itself for Windows 95, NT, or 3.1) ■ A complete data analysis system with thousands of on-screen customizable, presentation-quality graphs fully integrated with all procedures ■ Comprehensive Windows support, OLE (client and server), DDE, customizable *AutoTask* toolbars, pop-up menus ■ Multiple data-, results-, and graph-windows with *data-graph* links ■ The largest selection of statistics and graphs in a single system; comprehensive implementations of: Exploratory techniques with advanced brushing; multi-way tables with banners (presentation-quality reports); nonparametrics; distribution fitting; multiple regression; general nonlinear estimation; stepwise logit/probit; general ANCOVA/MANCOVA; variance components; stepwise discriminant analysis; log-linear analysis; confirmatory/exploratory factor analysis; cluster analysis; multidimensional scaling; canonical correlation; item analysis/reliability; correspondence analysis; survival analysis; a large selection of time series modeling/forecasting techniques; structural equation modeling with *Monte Carlo* simulations; and much more ■ On-line *Electronic Manual* with comprehensive introductions to each procedure and examples ■ Hypertext-based *Stats Advisor* expert system ■ Workbooks with multiple *AutoOpen* documents (e.g., graphs, reports) ■ Extensive data management facilities (fast spreadsheet of unlimited capacity with long formulas, *Drag-and-Drop*, *AutoFill*, *Auto-Recalculate*, split-screen/variable-speed scrolling, advanced Clipboard support, DDE links, hot links to graphs, relational merge, data verification/cleaning) ■ Powerful *STATISTICA BASIC* language (professional development environment) with matrix operations, full graphics support, and interface to external programs (*DLLs*) ■ Batch command language and editable macros, flexible "turn-key" and automation options, custom-designed procedures can be added to floating *Auto Task* toolbars ■ All output displayed in *Scrollsheets*™ (dynamic, customizable, presentation-quality tables with instant 2D, 3D, and multiple graphs) or word processor-style report editor (of unlimited capacity) that combines text and graphs ■ Extremely large analysis designs (e.g., correlation matrices up to 32,000x32,000, virtually unlimited ANOVA designs) ■ Megabyte Manager with up to 32,000 variables (8 Mb) per record ■ Unlimited size of files; extended ("quadruple") precision; unmatched speed ■ Exchanges data and graphs with other applications via DDE, OLE, or an extensive selection of file import/export facilities (incl. *ODBC* access to virtually all data bases and mainframe files) ■ Hundreds of types of graphs, incl. categorized multiple 2D and 3D graphs, ternary 2D/3D graphs, matrix plots, icons, and unique multivariate (e.g., 4D) graphs ■ Facilities to custom-design new graph types and add them permanently to menus or toolbars ■ On-screen graph customization with advanced drawing tools (e.g., scrolling and editing of complex objects in 32x real zoom mode), compound (nested) OLE documents, *Multiple-Graph AutoLayout Wizard*, templates, special effects, icons, page layout control for slides and printouts; unmatched speed of graph redraw ■ Interactive rotation, perspective and cross-sections of 3D displays ■ Large selection of tools for graphical exploration of data: extensive brushing tools with animation, fitting, smoothing, overlaying, spectral planes, projections, layered compressions, marked subsets ■ Price \$995.

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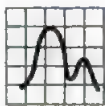
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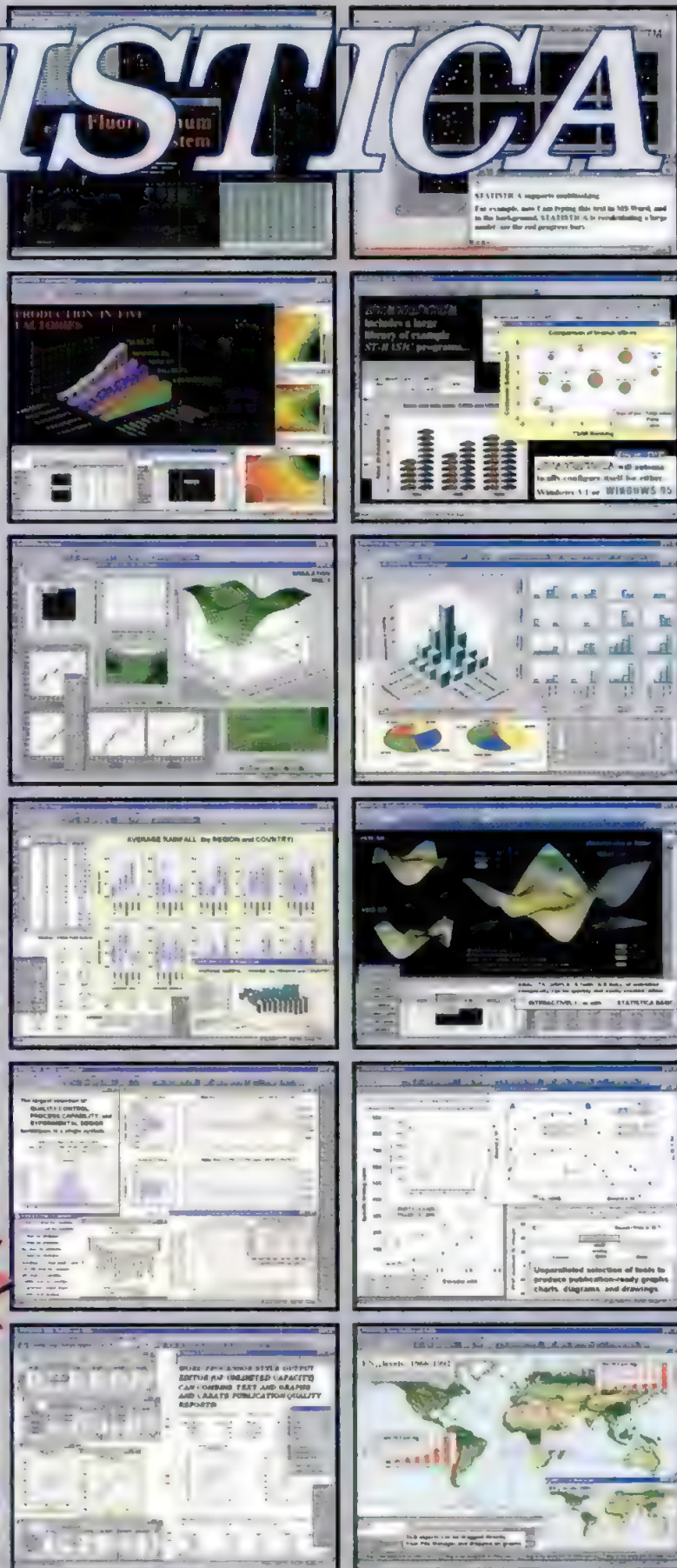
STATISTICA has received the highest rating in EVERY comparative review of statistics software in which it was featured, since its first release.



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- StatSoft Italia (Padova, Italy), ph: +39 49-893-4654, fax: +39 49-893-2897
- StatSoft Pacific Pty Ltd. (Australia), ph: +613 9521 4833, fax: +613 9521 4288
- StatSoft Japan (Tokyo, Japan), ph: +813 3667 1110, fax: +813 3668 3100
- StatSoft Taiwan (Taipei, Taiwan, R.O.C.), ph: +886 2 5706507, fax: +886 2 5703179



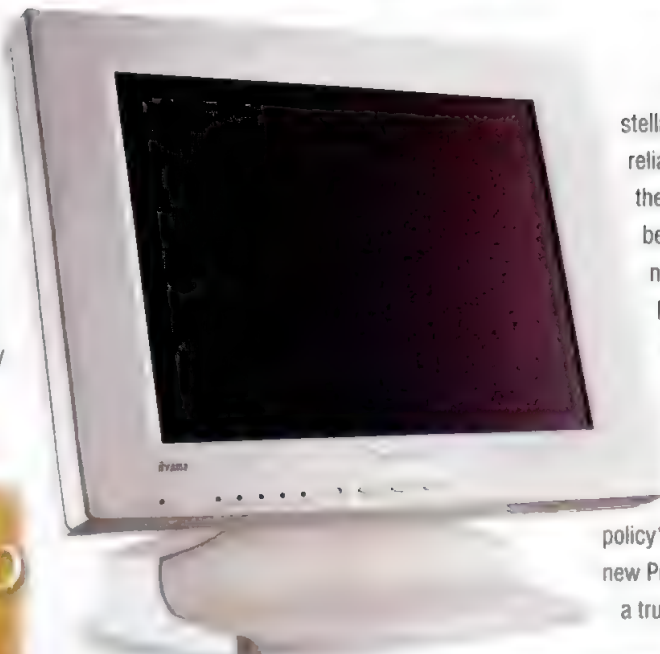
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First Looks



Capture the Web

Storing and organizing Web page content for archiving and viewing while off-line is made easier with the five products featured in this issue's roundup.

By Jan Ozer

The Web is long on information but short on tools to organize and tame that information. How many times have you researched a topic and lost track of your work because you failed to bookmark or print a page? Or found that by the time you went back to a page, the information you'd wanted to read was already gone?

These common experiences have spawned a category of tools so new that the category remains unnamed, perhaps contributing to the rampant word play of their titles: Catch-TheWeb, from Math Strategies; Hot Off The Web, from Insight Development Corp.; Surf-Saver, from askSam Systems; and Web Buddy, from Data Viz. The name of one product, Jet-

Fax's PaperMaster 98, reflects its pre-Web life as a digital storage cabinet for faxes, scanned pages, and other information. In the past, some of these tools have been dubbed "off-line browsers," yet that too, is a misnomer. A better example of an off-line browser would be the Microsoft Internet 4.0 feature that lets you schedule downloads of Web pages for off-line reading, with future updates replacing the previously downloaded page.

These tools provide the ability to store and organize Web page content for archiving and retrieving at a later time, all while retaining the original look and design of the Web page. Beyond this core feature set, however, functionality varies widely by product.

THROUGH THE RINGER

How do you test this diverse range of products? The most obvious criteria is the product's ability to grab pages of varied origin and content accurately. Although the Web started with static HTML, most advanced sites deliver dynamically generated pages customized to the user's request, using ActiveX, CGI scripts, JavaScript, and other components, not to mention Dynamic HTML (DHTML) and frames.

To test the products in this roundup, we went shopping at Amazon.com, Microsoft Expedia (www.expedia.com), NetBuyer (www.netbuyer.com), and analyzed investments at Microsoft Investor (investor.msn.com), Money (www.moneymag.com), and Yahoo and ZD Internet In-

INSIDE



CUSTOM PC:

Toshiba's Equium 100 features a pivoting LCD and can be configured to your specifications. See page 56.



MAKING MOVIES:

QuickTime 3 brings Apple into the realm of Real Networks and Microsoft. See pages 60 and 61 for the review as well as for a look at Macromedia's Flash 3.

CELERON:

Compaq's Deskpro EP 6266 incorporates Intel's new low-cost processor. See page 64.



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Ulead PhotoImpact 4.0	76

First Looks Online

For daily just-in-time reviews of shipping products, check out First Looks Online at www.firstlooks.com



First Looks

vestor (www.zdii.com). We researched topics at Infoseek, the Computer Magazine Archives (cma.zdnet.com), Sidewalk (sidewalk.com) and visited Godzilla (www.godzilla.com) and Thing-maker (www.thingworld.com) to grab some multimedia. We also browsed other sites to test specific capabilities like compatibility with frames and DHMTL. Not surprisingly, we saw huge differences in each product's abilities to capture these pages accurately, organize data, and share research.

Although all products were easy to use, we found significant differences in the time required to grab a single test page. To test the time required to capture a page, we visited PC Magazine's home page at www.pcmag.com.

All of the products in this roundup cost less than \$100, and most are under \$40, making them absolute steals for the value provided. Whether you search the Web for business or pleasure, you'll find that any one of these products will quickly become indispensable to your efforts.

Math Strategies

CatchTheWeb

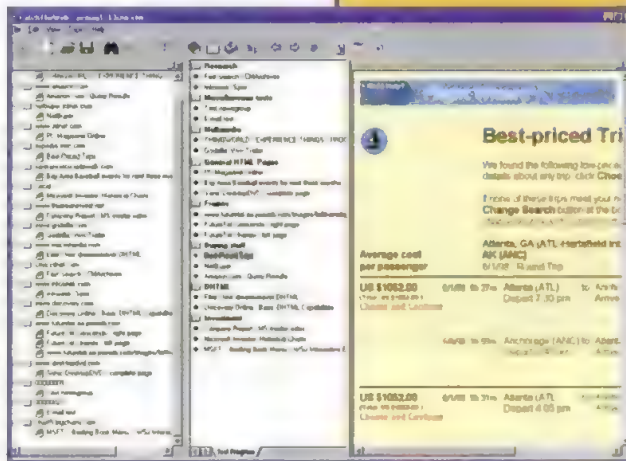


In the hyped-up world of the Internet, few programs actually deliver what they promise—and fewer still do it elegantly and affordably. But Math Strategies' gem of a program, CatchTheWeb, defies the odds and is ideal for organizing and delivering your Web research projects—

and it's an absolute steal at \$39.95.

CatchTheWeb (CTW) captures Web pages from Internet Explorer 3.0 and 4.0, pages

CatchTheWeb
List price: \$39.95
Requires: 32MB RAM, 10MB hard disk space, Microsoft Windows 95, 98, or NT 4.0, Microsoft Internet Explorer 3.0 or 4.0.
Math Strategies, Greensboro, NC, 336-855-7065; fax 336-292-0822
www.catchtheweb.com
Choose 404 at www.pcmag.com/infolink



under construction in Front-Page 98, and e-mail and newsgroup messages from Outlook Express. You then organize the data into self-contained presentations, playable on Netscape and IE browsers 3.0 and later.

During setup, the program installs a pushpin icon on the toolbar. From within IE 4.0, you capture Web content by dragging the pushpin onto the desired page, which launches a dialog box for entering the title, the topic (useful when conduct-

PLAY BALL: CatchTheWeb's top-notch organizational abilities let you create useful research projects.

ing searches), text notes, and chapter. The program automatically records the URL and

time and date of capture. You can also record partial pages by copying data from the Web page.

After capturing the document, you build a presentation in the Main Frame, which has four windows: the Archive Frame, which shows captured pages grouped by original Web site; the Topics Frame, which or-

More of the Web's Little Helpers

Most of us have a few Web sites we monitor frequently—whether they're competitors', customers', news, or investment sites. Given the Web's often flaky performance, this process can be frustrating and time consuming. Tierra Communications' Highlights2 (\$49.95 list) does this for you—quickly and more accurately than you could ever do yourself.

The program works with "assistants" that monitor a single site. During setup, you select the page and determine how frequently to check the site. You can elect to be notified of any change (useful for monitoring the competition) or select key words to trigger notification (helpful in monitoring a news site).

If a monitored page adds a link, you can elect to retrieve the hyperlinked page as well. Other options include the ability to set a priority level that changes the urgency of the notification and to store images remotely or locally.

Sometimes knowing when to look is as important as knowing where to look. If you supply the where, Tierra Highlights2 will supply the when.

Tierra Highlights2. List price: \$49.95. Tierra Communications, Ashton, Ontario, Canada; 613-253-2577; www.tierra.com. Choose 417 at www.pcmag.com/infolink.

WEBWHACKER 4

One problem with all new product concepts is making the technology accessible to end users. Rather than build on the browser concept, Blue Squirrel WebWhacker 4 (\$49.95 list) works within a product familiar to even more users—Windows Explorer.

Scheduled for release in late 1998, we looked at an alpha version of WebWhacker. The interface is modeled after Windows Explorer, with a column on the left containing folders, a middle column containing files, and an embedded browser on the right. Browse over to the desired page and a floating toolbar will launch a wizard to guide you through all capture options.

WebWhacker 4 can capture complete Web sites or discrete pages, in either real time or on a scheduled basis. You can choose which file types to include or exclude from the download by file extension, file size, or MIME filters. Click on a file in the Explorer window, and the file is opened.

WebWhacker's interface comes close to making the Web feel like one big accessible hard disk. Though it requires Internet Explorer 3.0 or later to create the embedded browser, WebWhacker can grab sites from any browser.—**JO WebWhacker 4.** List price: \$49.95. Blue Squirrel, Draper, Utah; 800-403-0925, 801-523-1063; www.bluesquirrel.com. Choose 418 at www.pcmag.com/infolink.

ganizes content by Topic and Chapter; the Notes Frame, which displays annotations made during capture; and the Browser Frame, which contains an instance of Internet Explorer to display Web page contents.

You organize your presentation into "chapters" and rename and change page order at will. This structured flexibility lets you build and deliver highly organized research projects and is a key advantage over other programs. Once you're done, you create a cover page with title, author, and e-mail information, and compile your presentation.

You have the option of including captured content only or coupling that content with bookmarks, which allow those with an Internet connection to view the document online (bookmarks may also be sent separately). This option is ideal for sites that contain multimedia or other content not collected during data capture.

You publish in three forms: a self-running 16-bit executable that automatically launches your Web browser, a Zip file, or an uncompressed "bookmark only" presentation. The JavaScript-driven presentation is frames-based, with the left frame containing the documents organized by chapter and the right frame containing the Web page with notes displayed in a panel on the screen bottom.

The initial release that we tested, Version 1.03, had difficulties capturing pages with frames, but this was resolved in the beta of Version 1.04. CTW also failed to capture Active-X-driven stock graphs in Microsoft Investor, but the graphs successfully loaded using the bookmarks feature.

Other than these issues, CTW handled every other page we attempted, proving to be one of the most compatible products in this roundup. CTW was also a rela-

tively swift performer, capturing our PC Magazine Online home page in 21 seconds. The package added about 100K in overhead to mailed messages—slightly more than Hot Off The Web.

Simple, accessible, and effective, CTW is absolutely essential if you're researching information for delivery to others. But even if you're organizing content for your own use, \$39.95 is an incredibly small price to pay to organize your Web ramblings and to avoid searching again for information you remember you saw—but just can't remember where.

Insight Development Corp.

Hot Off The Web

Insight Development Corp.'s \$50 Hot Off The Web (HOTW) offers the unique ability to capture and creatively annotate Web pages for e-mail or storage with the digital equivalent of self-stick notes, plus and a whole lot more. Although the program worked well with basic HTML, it stumbled on dynamically generated and frames-based pages and didn't retain hypertext links

Editors' Choice

• CatchTheWeb



Although all five programs have their strengths, only one program—CatchTheWeb, from

Math Strategies—provides an optimal mix of compatibility and organizational prowess, along with the ability to consolidate findings into a self-running executable that makes sharing a snap. Though other programs offer more features, none is so elegantly effective at the intended purpose. At \$39.95, CatchTheWeb is a bargain at twice the price.

Our honorable mention, SurfSaver from ask Sam Systems, is ideal for those who like to surf fast and light. Storing pages in a default directory takes only one right mouse click, and SurfSaver stores files faster than any other program. A well-featured search function helps make sense of what you've captured once you're off-line.

in the captured HTML.

During setup, HOTW installs a resident program with an icon on the taskbar. You capture content by opening the target page in Internet Explorer 4.0 and then pressing the icon, which loads the page into the HOTW application. Once the data is captured, you have four annotation options: a freeform Graffiti Pen customizable for both color and thickness; a text Highlighter (with color options); Cyber Notes, which are essentially placeholders for text messages (with font, size, and color options); and Digital Stickers,

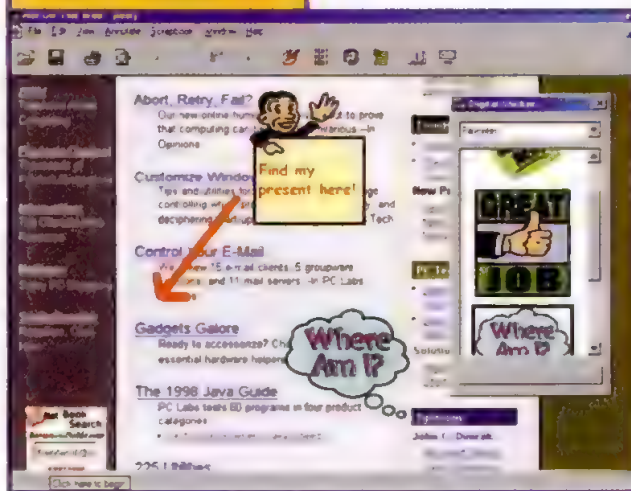
which contain messages like Confidential or Great Job.

All annotations sit on floating HTML layers that you can move, edit, or delete over the captured HTML. When finished, you can e-mail the annotated page to a remote user. HOTW creates a self-running executable that automatically opens in the recipient's default browser or in HOTW, if installed. Either way, the program doesn't preserve hyperlinks, so recipients can't follow links to other pages.

You can save entire pages or any portion of a page in a scrapbook, though when we did, we experienced frequent errors, which ranged from minor formatting changes to total page loss. The scrapbook stores pages sequentially, separated by lines with URLs and capture time, but there's no provision for searching—a drawback for those compiling research projects.

HOTW performed well with normal HTML pages but degraded quickly in the face of more complicated pages. For example, HOTW captures frames individually on separate pages and doesn't combine them. Furthermore, the program general-

Hot Off The Web
Street price: \$50
Requires: 16MB RAM (24MB for Windows NT) 5MB hard disk space, Microsoft Windows 95 or NT 4.0
Insight Development Corp., San Ramon, CA, 800 825-4115, 925-244-2000
www.hotofftheweb.com
Choose 402 at www.pcmag.com or infoink



MARKERS:

Hot Off The Web offers the most annotation options of any product in this roundup.

First Looks

ly can't handle pages with dynamic content, whether driven by plain CGI or JavaScript. This hampered use while researching air fares (Expedia), pricing computer products (NetBuyer), and searching for books (Amazon.com) and computer-related articles (CMA Archives). The program worked well with Infoseek and Yahoo searches.

On our tests, HOTW was a slow performer, capturing the PC Magazine Online home page in 52 seconds. In terms of file size, HOTW is relatively efficient, adding only about 80K of file overhead to mailed messages, not including annotations. Although HOTW works with Netscape Navigator 4.0 for both capture and receiving messages, Internet Explorer 4.0 provides for maximum compatibility.

If you frequently e-mail portions of Web pages to friends and business associates, HOTW has undeniable appeal. Just be prepared to live with occasional incompatibilities and don't expect the program to perform robust double duty as the locus of your Web-oriented research projects.

rates elements of Documagix's PaperMaster Live and HotPage products—had competent Internet capabilities, other programs provide superior functionality at less than half of its \$100 price.

The program installs a capture menu in all compatible browsers during setup, accessed from the File menu in Internet Explorer and on the main menu bar in Netscape browsers. These controls allow you to capture a page in HTML format, rasterized print output (the predominant format used for most non-Web-based documents), or both. HTML pages are much smaller in size and retain hypertext links, while rasterized pages lose all internal links and vary in size by complexity, averaging around 100K, and

drawer and folder to view the captured documents, which you can sort by title, date and time of capture, or manually via drag-and-drop. You can also drag documents to different drawers and folders, a convenience when organizing your captured pages. Double clicking on an HTML document launches your browser and displays the stored page.

In general, the program's features are much more flexible for raster than for HTML output. For example, you can mark up a raster image with various annotations; the same capabilities are not available for HTML documents, however. Similarly, you can e-mail raster images but not HTML source pages. A simple keyword search function lets you search both the title and body of captured HTML. When PaperMaster rasterizes a Web page, it retains a copy of the HTML text, enabling keyword searches of raster documents.

Though flawless when converting pages to raster format, PaperMaster's performance in capturing HTML documents was erratic and often browser

askSam Systems

SurfSaver

If your goal is to blast through a bunch of Web pages and then later sift through the results, askSam's \$39.95 SurfSaver is the product for you. The program stores files quickly and correctly and has the most functional search engine of the products in this roundup.

SurfSaver currently works only with Internet Explorer 4.0; a Netscape version is due in July. The program is designed to be a self-contained filing cabinet, with both searching and reviewing performed from the same browser on the same computer.

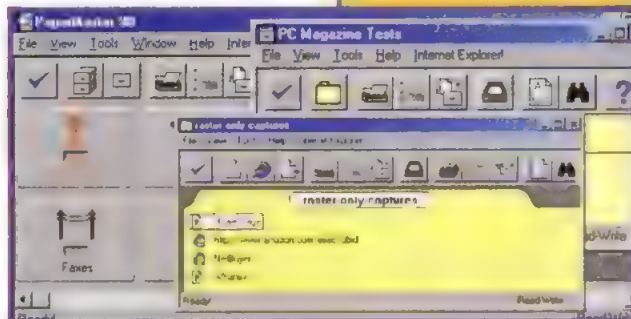
Aided by an unobtrusive interface, SurfSaver makes it easy to grab Web pages with a simple right click from within IE. Selecting SurfSaver Save launches a dialog box that lets you input the page title, keyword search terms, and notes up to 10K in size. You also designate a folder to store the data.

Press OK and the program downloads and saves the page, along with the date and time of storage and the page's URL. Or you can select SurfSaver QuickSave, which automatically stores the page in a designated folder with no dialog box.

Capture options include the ability to save space and time by not storing graphics files and to speed capture time by retrieving only cached data. Even without these options enabled, SurfSaver was our fastest performer, capturing the PC Magazine Online home page in 5 seconds.

You access stored information by right clicking on the browser and selecting SurfSaver Search. Highly functional search capabilities include search by title, keywords, notes, URL, or date of capture. The more advanced Near Search function identifies documents that have two words within a certain number of words from each other, or on the same line, sentence, or paragraph.

JetFax Inc., Menlo Park, CA, 800-753-8329, 650-324-0600
www.jetfax.com
Choose 403 at www.pcmag.com/infoink



JetFax

PaperMaster 98

In contrast with the other, Web-specific programs in this roundup, JetFax's PaperMaster 98 handles documents from many sources, including Internet pages, faxes, scanned input, and rasterized print output from Windows applications. (JetFax recently acquired Documagix Corp., the publisher of previous incarnations of PaperMaster.) Although PaperMaster—which incorpo-

occasionally exceeding 350K.

The main program resembles an on-screen filing cabinet, and uses the file drawer/folder metaphor for storing documents. When you capture the data, you designate where to store the document, which you can save either with or without images and plug-ins. Although you can't annotate documents during the capture process, the URL, time and date of capture, and document size are automatically recorded.

You double-click on a file

FILE AWAY: The easy-to-use filing cabinet metaphor of PaperMaster 98 tends to get cluttered.

Amazon.com, the Computer Magazine Archive, and NetBuyer using the latest versions of Netscape Navigator and Internet Explorer. Working from Navigator, PaperMaster correctly captured results from Money, Infoseek and Yahoo, but failed at all three from Internet Explorer. Performance times were comparatively quick: The program captured the PC Magazine Online home page in 22 seconds.

All in all, PaperMaster's Web capabilities are a valuable addition to a general-purpose product. But if your focus is the Web, you can find less expensive products with superior functionality.

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(watching movies is "research" for Marne)
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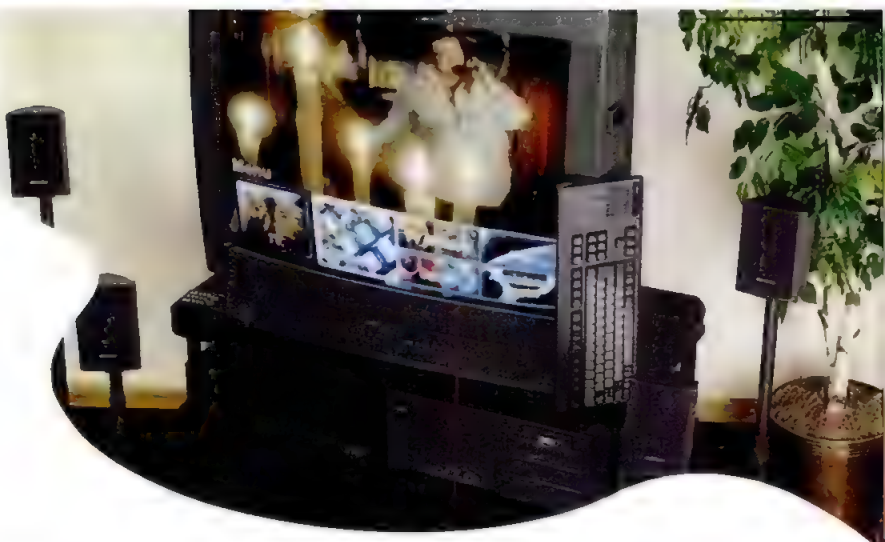
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- **Education Bundle** - Grades K-3 Reader Rabbit® 1; Math Rabbit®; Let's Start Learning!™; Interactive Math Journey®; Reader Rabbit's Interactive Reading Journey® 1; Paint, Write, Play!™ & Ultimate Children's Encyclopedia™. **\$99**
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First Looks

Alternatively, you can simply list the records saved in each folder, which appear in spreadsheet form with two columns, one for title and the other for capture data. Touch a record and it displays a split-screen in the browser above the search screen; all of the page's hypertext links are preserved.

Although you can easily go to the original URL from within the search screen, other features are limited. For example, records are listed in order of capture, and you can't change that order, effectively preventing you from organizing records within a folder. Another caveat: There's no easy way to transfer your results from one location to another.

The first version of SurfSaver that we tested, 1.0, had significant problems capturing pages with dynamic content. During our tests, however, askSam introduced version 1.0b, which proved adept at capturing virtually all tested content, making SurfSaver one of the most compatible products in this roundup.

SurfSaver is fast, highly functional, and well-integrated into the IE environment. Although the product is ideal for those seeking to track their Web ramblings, the lack of organizational capabilities make SurfSaver less suitable for those trying to pull this data into a cohesive whole.

DataViz

Web Buddy

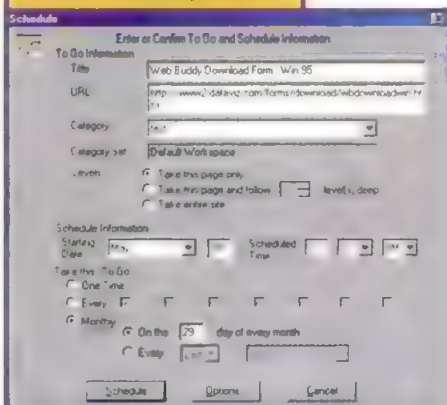
DataViz's Web Buddy (\$39.95) offers the broadest Web-oriented feature set of all the products in this roundup—including scheduled page downloading—but it was among the least capable of the reviewed packages when it came to capturing dynamically generated pages. Web Buddy is ideal for repetitive tasks with known compatible pages but unsuitable for most real-time, stream-of-consciousness surfing.

WEB PAL: Web Buddy was the only product here that could schedule times for Web page downloads.

Web Buddy offers an extensive feature set with page, branch, and Web-site grabbing capabilities in real time and on a scheduled basis. Other Web-friendly features include the ability to convert HTML to Word documents and to import Netscape bookmarks.

You control capture activities with the Web Buddy Toolbar, which offers a range of

Web Buddy
List price: \$39.95
Requires: 4MB RAM, 5MB hard disk space, Microsoft Windows 95
DataViz Inc., Trumbull, CT, 800-733-0030, 203-268-0030
www.dataviz.com
Choose 401 at www.pcmag.com/infolink



configuration options. Unique is the ability to grab external documents referred to in the target page, with user-configurable limits on the number of external levels that can be captured. Web Buddy can also download many multimedia formats, including AVI files and QuickTime, but only if the file is directly referenced in the HTML page. This limits the program's use with formats like NetShow and RealVideo, both of which use token files.

When you capture a document, you can modify the title (which otherwise defaults to the page title) and select a category to store the document. Then you

FAST SURFER: SurfSaver's key strength lies in the flexibility of search engine.

can capture the page immediately, schedule the grab for later in the day, or repetitively grab the page on a weekly or monthly basis.

Grabbed pages are stored by category in Web Buddy Central along with extensive information about the site, including capture options, size, levels, download date and time, URL, and a map of the stored pages. Pages are presented in a three-column spreadsheet that can

be sorted by title, URL, and date and time of last download. You can also rename pages, move them between categories, or delete them. Double clicking on a page loads it into the default browser with its hypertext links preserved.

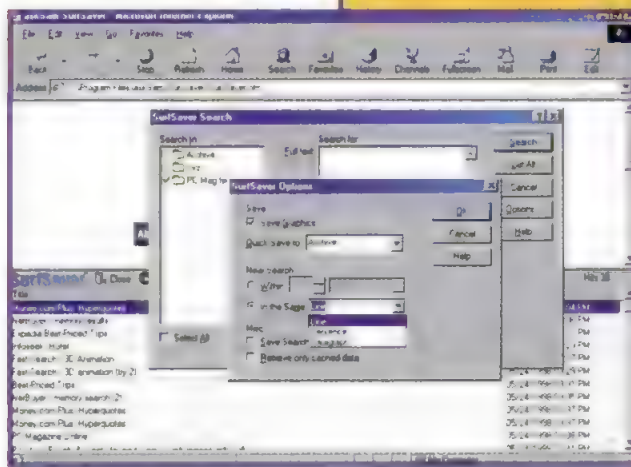
Categories of pages can be made public for multiuser access over a network, or moved between machines either via a network or through removable storage media. Web Buddy's categories are comprised of multiple directories and files, though, making them difficult to deliver via e-mail. Furthermore, the recipient would need Web Buddy installed in order to read the categories on their system.

Web Buddy captures pages by sending the URL back to the site and regenerating the page. Unfortunately, this approach fares poorly with many dynamically generated pages, causing Web Buddy to fail when used at Amazon.com, Expedia, Microsoft Investor, Money.com, and NetBuyer.

Since Web Buddy essentially redownloads the page during capture: Its cycle time was the longest in the roundup, taking 1 minute 43 seconds for the PC Magazine Online home page. On the plus side, Web Buddy was our most universally compatible product, supporting Navigator Version 1.1 and later, Internet Explorer Version 2.0 and later, and Enhanced Mosaic.

Users who need to download entire Web sites or pages at scheduled intervals will find Web Buddy to be an invaluable tool. But if your goal is to do general Web-based research, we'd suggest you choose another of the products in this roundup.

SurfSaver
List price: \$39.95 (\$29.95 download)
Requires: 4MB RAM, 1.5MB hard disk space, Microsoft Windows 95, 98 or NT, Microsoft Internet Explorer 4.0
askSam Systems, Perry, FL, 800-800-1997, 850-584-6590
www.surfsaver.com
Choose 400 at www.pcmag.com/infolink



HOME PCs

Supercharged!

Compaq redefines the state of the art for home PCs with its Windows 98-powered Presario 5600.

By Carol Venezia

When was the last time a home PC blew your mind and knocked your socks off? If it's been a while, go to a store and check out the new Compaq Presario 5600: The box may be beige, but there's more innovation under the hood than we've ever seen in a home PC.

To take advantage of Windows 98's built-in driver support for USB and FireWire, Compaq has integrated two of the former and one of the latter ports right on the front of the Presario's mini-tower case, concealed behind a flip-up door (there's also a FireWire port on the back of the PC). These are part of the system's Digital Creativity Imaging Center, which also provides the software tools to create, enhance, and edit both still and moving video images.

Turn the Presario around and you'll find more goodies, including ports for the system's PCI-based 56K V.90 modem. There's also an RJ45 connector for the unit's integrated 10-Mbps Ethernet adapter, so you'll be ready to start up your own home network or to hook up a cable modem.

There are two external connectors on the Presario's graphics board—one each for a standard CRT and a Digital Flat Panel interface. The latter ports the video signal directly out from the graphics accelerator to the FP500 Flat Panel Monitor, a 14.1-inch TFT panel with an integrated microphone. Because analog-to-digital conversion is not involved, picture quality is superb. Compaq is the first home PC vendor to offer flat panels at an affordable price (\$1,000 street).

The Presario is powered by a 400-MHz Pentium II CPU and also features 128MB of 100-SDRAM, a 12.9GB hard disk, and a DVD-ROM drive. On our

benchmark tests, this PC burned up the charts, posting scores on our Winstone, Graphics WinMark, and 3D WinMark tests that rivalled the top scores recorded in our first 400-MHz Pentium II roundup (May 26, 1998).

On the software side, in addition to the basic productivity applications like Works and Quick-

en, you'll find lots of preloaded software geared toward enhancing your online experience. Getting online is easy: Just click on the "Set up Internet Here" icon and you'll soon be test-driving your 50 free hours of access through GTE Internet Services.

If you're looking for a Windows 98 home PC that has it all,

UP FRONT: The 5600's front-of-chassis USB and FireWire ports.

the Compaq Presario 5600 is the machine for you.

Compaq Presario 5600. Street price: \$2,700 with 400-MHz Pentium II CPU, 128MB SDRAM, 12.9GB hard disk. FP500 Flat Panel Monitor: \$1,000. Compaq Computer Corp., Houston; 800-345-1518, 281-370-0670; www.compaq.com.

PC PERIPHERALS

Video Capture on the Fly

LifeView's versatile pair of video-capture kits bring convenience and low cost to PC and Internet video.

By Bruce Brown

Full-motion video capture for multimedia production and Internet communications may be less expensive than you think with LifeView's Fly Video kits. The least expensive way to start is with the Fly Video Basic kit (\$100 street), which comes with a CMOS color camera, capture card, microphone, cables, and Smith Micro Video-

video capture. The color cameras are powered by an included keyboard passthrough cable. The CMOS camera in the Basic kit captures relatively rough images—with adjustments for brightness, contrast, hue, and saturation. The 0.3-inch CCD camera in the Deluxe kit produces finer, 270,000-pixel images.

When you start the Fly Video application, a partial-screen window opens with video image, clickable to full-screen. A menu bar lets you select from A/V1, A/V2, and S-video inputs; the board in the Deluxe kit also has a coaxial antenna or cable connector. A utility divides the screen into many windows that display the same image;



TV TUNER: The Deluxe kit includes a TV tuner.

Link video e-mail software. Fly Video Deluxe (\$190 street) upgrades to a 0.3-inch CCD color camera, a capture card with a BrookTree TV tuner, and VDOnet's VDOPhone CD.

Each kit gives you all you need for full-motion and still

the number of windows is determined by the video mode (16 windows in 640-by-480 resolution to a maximum 100 windows at 1,600-by-1,200).

In video-capture mode using the camera, the windows update sequentially. Used with the

Deluxe kit's television input, the split-window mode displays multiple copies of the same channel or can scan to display a different channel in each window for monitoring.

Screen capture, whether a single image or full-motion video, is simple: Click on the screen and a capture menu pops up. In an options screen you can set the maximum capture length in seconds, choose to include audio content, and select the compression mode.

Capture and playback rate are dependent on CPU, memory, resolution, and color depth, with a maximum 30-fps rating. In testing with a 166-MHz Pentium/MMX with 32MB of RAM in 640-by-480 16-bit color mode, television capture played back smoothly, but video capture with the camera occasionally paused.

The Fly Video Basic kit lets you get started with Internet video communications for e-mail or videoconferencing at a very low cost. The Deluxe kit adds a better camera and a TV tuner for higher quality captures and greater versatility.

Fly Video Basic. Street price: \$100. **Fly Video Deluxe.** Street price: \$190. Requires: 8MB RAM, 4MB hard disk space, Microsoft Windows 3.1 or 95. LifeView Inc., Fremont, CA; 510-661-2968, fax: 510-661-2978; www.lifeview.com.tw. Choose 415 at www.pcmag.com/infolink.

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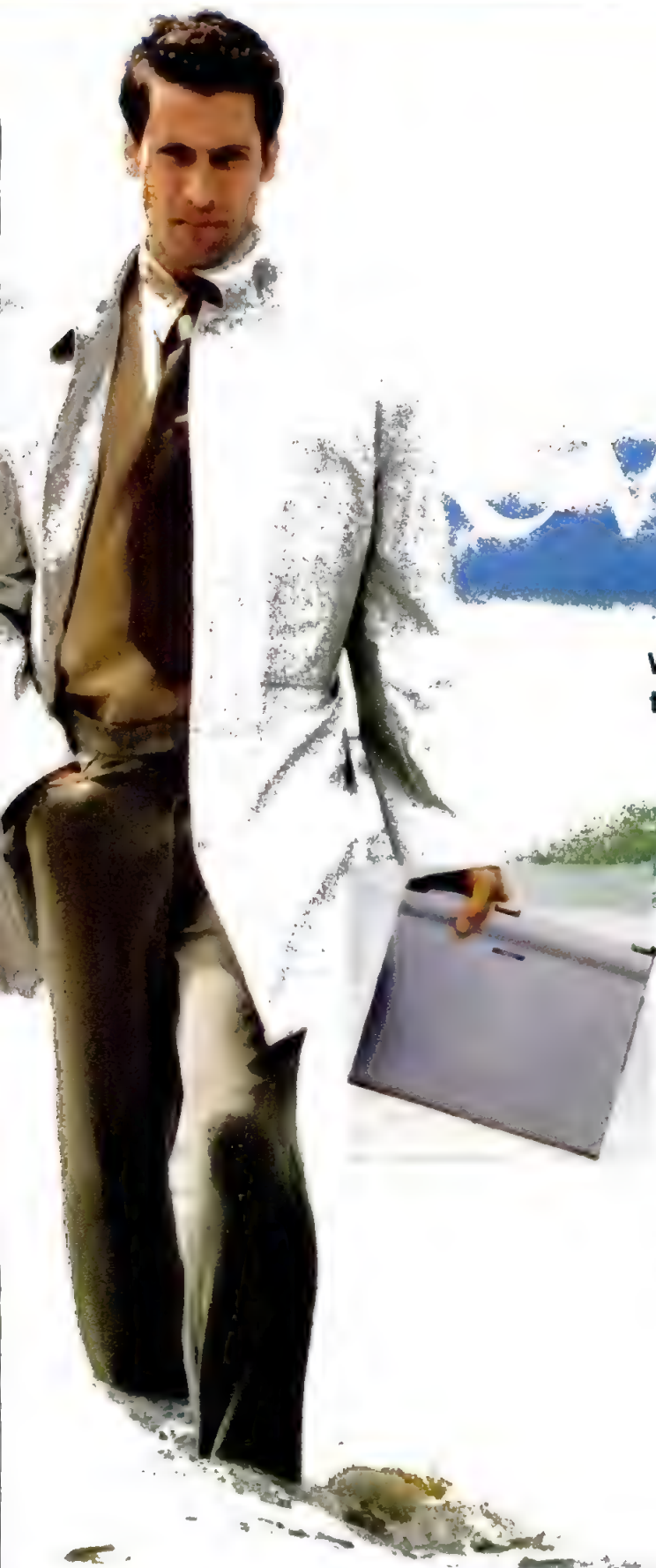
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First Looks

PCs

Pivot in High Style

Toshiba's new Equium 100 combines a powerful Pentium II CPU with an integrated, pivoting LCD.

By Carol Venezia

If you've ever had to outfit a cramped cubicle or a high-profile area such as an executive office with a PC, you know that sometimes the standard beige box just doesn't cut it. Enter Toshiba's \$3,300 (street) Equium 100, an all-in-one PC design that marries a powerful 333-MHz Pentium II processor with a gorgeous, pivoting LCD display.

Standing just 11 inches tall, 14 inches wide, and about 10 inches deep with the front-mounted LCD tilted to a comfortable viewing angle, the Equium takes up less space on your desk than a conventional 17-inch CRT. But don't be fooled: There's nothing at all conventional about the Equium 100's 15-inch digital flat-panel screen.

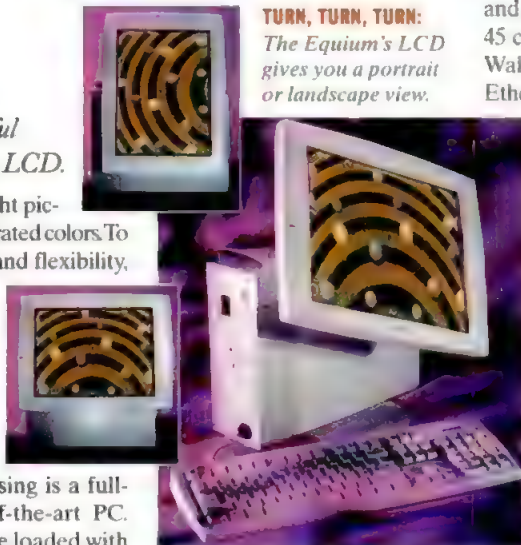
This SVGA panel produces an

exceptionally bright picture with well-saturated colors. To add to its appeal and flexibility, the display pivots 90 degrees, so you can view images in either portrait or landscape mode.

Packed into this efficient housing is a full-powered, state-of-the-art PC. Our test unit came loaded with a 333-MHz Pentium II with 64MB of RAM, a 3GB hard disk, and Windows 95; but build-to-order models are available with 266- or 300-MHz CPUs, 32 or 128MB of RAM, 4GB hard disks, and Windows NT.

You're probably wondering how all of these components fit into such a small environment. The answer is innovation: Toshiba

TURN, TURN, TURN:
The Equium's LCD gives you a portrait or landscape view.



heavily leveraged its expertise in building notebooks when designing the Equium 100. Inside, you'll find a 16X CD-ROM drive and a floppy disk drive, which are actually 10.7mm-high devices traditionally used in portables.

Concealed by a swing-out panel, you'll find the standard array of I/O ports, plus two USB ports, a video-out port, speaker

and mic jacks, as well as an RJ-45 connector for the machine's Wake-on-LAN-capable Fast Ethernet adapter. There's also an empty 3.5-inch drive bay, a lock slot, and a space for an additional PCI card. We suggest loading up on the components when you order the machine, however, because this PC is somewhat difficult to get in and out of.

The DMI- and ACPI-compliant Equium 100 stands ready to be a good corporate citizen, with Intel's LANdesk Client preloaded. For specialized environments, this stylish Toshiba product will make quite an impact.

Toshiba Equium 100. Street price: \$3,300 with 333-MHz Pentium II CPU, 64MB RAM, 3GB hard disk, 16X CD-ROM drive, Windows 95. Toshiba America Information Systems Inc., Irvine, CA; 888-598-7802; fax, 714-457-7777; computers.toshiba.com. Choose 413 at www.pcmag.com/infolink.

PERIPHERALS

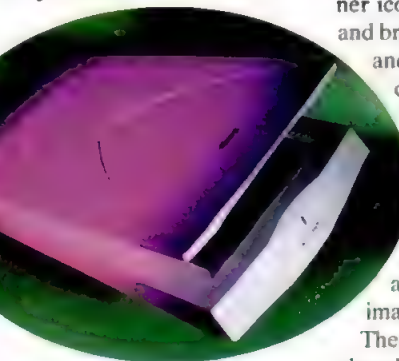
Scanning in 3-D

Memtek puts a new twist on the flatbed scanner with its 3-D-capable device.

By Daniel Grotta and Sally Wiener Grotta

Flatbed scanners have no problems with two-dimensional, flat originals, but because of limited depth of field and scanner arm mechanics, they aren't particularly well-suited for objects with height, width, and depth. The \$150 Memtek Memorex SCF 9360P 3D Flatbed Scanner is designed to scan 3-D objects, but its slow speed and lack of a backlight somewhat limits its usefulness.

The Memorex 3D looks and works like most other 30-bit parallel scanners, with one exception. The oversized cover is hinged so that if an object fits on



the 8.5- by 11.7-inch scan area and the cover can be closed, the item can be scanned. The scanner can't actually trace around the physical contours of an object—after all, its arm is able to move along a flat plane only—the lens' depth of field will render the sides of an object in sharp focus.

Installation and setup are both very easy. The ports are clearly marked, and all other instructions are on Quick Installation sheet. Clicking on the scanner icon activates the scanner and brings up a simple preview and function screen. User controls are limited to dpi setting, size, scanning type, contrast, brightness, and crude color balance. Clicking on the scanning button activates the scan and automatically saves the image as a TIFF file.

The scanned images are displayed as thumbnails, which can then be dropped into destination icons that will launch a program (Word, Excel, or the bundled TextBridge OCR), bring up Memorex's image-editing program, drop the user into a slide-editing program, activate the printer, or send e-mail.

Even for a parallel-port device,

the Memorex 3D is quite slow. The scanner took just over 4 minutes to complete a 300-dpi, 8.5- by 11.7-inch scan. The quality of 2-D scans was good—about what we'd expect from a 300- by 600-dpi, 30-bit scanner. Scanned 3-D objects display depth and detail, but the lack of a secondary light source in the cover creates a dull background and a distracting shadow around each item.

The Memorex 3D may be a compromise choice if you want an affordable, conventional flatbed with flawed but workable 3-D capability. A better, albeit more expensive solution, is to use a digital camera in macro mode. **Memtek Memorex SCF 9360P 3D Flatbed Scanner.** Street price: \$150. Requires: 8MB RAM, 50MB hard disk space, Microsoft Windows 3.1 or later. Memtek Products Inc., Santa Fe Springs, CA; 800-636-8352, 562-906-2800; www.memorex.com. Choose 414 at www.pcmag.com/infolink.

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committee drills one department head after another on escalating costs. How are you going to ¹(get the newly acquired subsidiary onto our e-mail system)? How are you going to ²(hold down your network administration head count) as you add hundreds of new users? How can you afford to ³(roll out new apps to the whole company)? It's like the Spanish Inquisition, but the food is worse. Her stomach rumbles from the dry turkey sandwich and yuppie water served at the start of the meeting as one committee member wakes up long enough to ask about the ⁴(Year 2000 problem) he saw on a CNN segment. "Not a problem, we have it covered," she replies. With an unforeseen compliment for completing the ⁵(global supplier extranet) project, she is excused. Exiting, she smiles at the beleaguered marketing director, who is about to be skewered because the company's celebrity pitchman has just appeared on the cover of a supermarket tabloid.

THE ⁶(BEST PARTS) OF HER MEETING WERE MADE POSSIBLE BY LOTUS.

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STREAMING VIDEO

Crossing Platforms

With QuickTime 3, Apple releases its first tools for Windows, including a new video editor.

By Jan Ozer

Look at QuickTime, the development architecture from Apple, and you see the roots of many of the breakthrough features offered by Microsoft, RealNetworks, and other streaming-video vendors. From streaming text and bitmaps with synchronized audio to client-side special effects, QuickTime had it first. Unfortunately, being first out of the gate doesn't necessarily win the race. In this case, the winner will be the one that first delivers a well-featured product with support tools on all relevant operating systems.

With QuickTime 3, Apple releases its first-ever development tools for Windows, placing itself in competition with Microsoft and RealNetworks on several fronts. In the CD-ROM marketplace, QuickTime is as good as it gets. For Web developers, however, critical feature gaps limit the product's appeal for delivering high-volume streaming audio and video over the Internet or intranets. That said, the absolute breadth of QuickTime formats makes it an irresistible mechanism for garnishing your site with sprites, 3-D VR panoramas, and other media elements.

DECONSTRUCTING QUICKTIME

Like the proverbial elephant, QuickTime feels different depending on where you touch it. To consumers, the Movie Player is a free player/plug-in. To Web authors and CD-ROM developers, QuickTime is an application environment for building content to distribute on the Macintosh, Windows 95, and NT plat-

forms. You can start by downloading the \$29.99 upgrade that converts the Movie Player into QuickTime 3 Pro. Finally, to developers of video editors, capture cards, and other multimedia tools, QuickTime is an architecture that cuts development time.

Two features are central to all these applications. The first feature is the extensive file format



FAST STREAM: QuickTime's client-side rendering makes for compact special effects.

that enables the synchronization of an unrivaled range of media types. The second is an architecture that includes over 200 transitions and 12 image filters, as well as compatibility with a range of media types.

Our QuickTime review focused on QuickTime's applicability to CD-ROM and Web development—particularly for audio, video, and streaming media file types. We do not address other elements such as QuickTime VR or QuickDraw 3D.

CD-ROM SPACE

In the relatively bandwidth-unrestricted CD-ROM world, QuickTime's file formats offer a range of development options unavailable from any other architecture. One key example is multiple-track publishing, which allows developers to create one file with multiple language and

subtitle text tracks. At playback time, if the user has not selected a language, Movie Player will use the language of the operating system. QuickTime performed on our tests as advertised, creating a multitrack file barely larger than the sum of its parts and with the ability to select tracks at will.

On the codec front, QuickTime 3 includes a new video compression technology called the Sorenson Video compressor, a significant improvement over older QuickTime codecs. For example, on talking-head clips, Sorenson delivered artifact-free video at 320-by-240 resolution and 15 fps at 50 Kbps, easily outdistancing Cinepak and Indeo 4.4, the only other two QuickTime CD-ROM codecs.

Performance dropped significantly, however, with higher-motion clips that required bandwidths in excess of 100 Kbps to remove all artifacts. Even at that bandwidth, Sorenson clearly represents a boon to QuickTime developers seeking to pack more video onto one CD-ROM. Note that to fully unlock Sorenson's capabilities, you have to purchase extra software from Sorenson Vision or third-party developer Terran Interactive.

QUICKTIME AND THE INTERNET

In addition to cross-platform support, Apple focused QuickTime 3.0 on the Internet, adding low-bandwidth audio and video codecs, support for URL hotspots, and customizable movie delivery according to the remote user's Internet connection speed.

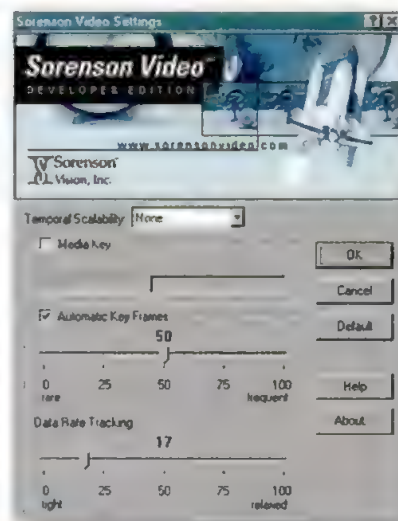
Missing, however, is a server component to dole out the streaming media to remote users. This significant deficit will cause many high-volume consumers of intranet video to seek another solution. On most intranets, streaming media is just another format vying for its share

of bandwidth on the corporate network. Since streaming video files tend to be comparatively large, most network administrators balk at installing streaming video without controls over video bandwidth consumption.

Most server-based streaming solutions, including NetShow and RealVideo, can limit video consumption by total bandwidth, stream count, or both. This ensures that total video consumption will never swamp the network. Lack of a server prevents QuickTime from being used for multicast transmissions, a bandwidth-savvy mechanism for streaming video across an enterprise. Also significant is that QuickTime has no real-time capabilities and can't be used for live-event broadcasting.

LOW-BANDWIDTH BLUES

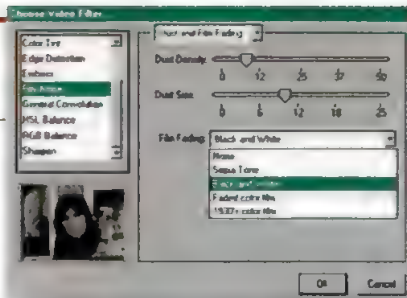
The importance of a server lessens on the Internet. Here, pure format quality becomes paramount, and on our tests neither the QuickTime nor any



CD QUALITY: Sorenson delivered outstanding quality for CD-ROM publishing in the 50 to 100Kbps range.

other Sorenson codec could match the quality provided by either NetShow or RealVideo.

To reach this conclusion, we compared high- and low-motion clips compressed at 20, 64, and 128 Kbps at 176-by-132 and 320-



FADE IN: QuickTime Pro offers a variety of sophisticated special effects.

by-240 resolution, all at 15 fps. On our tests, Sorenson video became blocky during periods of even moderate motion, breaking into extreme blockiness in high-motion segments such as dissolves between segments.

QuickTime's low-bandwidth audio codecs proved comparable to those offered by NetShow and RealNetworks, allowing QuickTime to create very compelling presentations with audio and synchronized images, text, sprites, or other media. QuickTime also offers more than 200 MIDI instruments, which provide very good low-bandwidth quality. In addition, QuickTime renders several special effects on the client computer, dramatically reducing download time.

The sum of QuickTime's parts overwhelmingly compensates for occasional shortcomings, making the format worthy of review by all content developers. Just be prepared to hunt for a range of applets, some unavailable on the Windows platform, to achieve your results.

THE COMPETITION

No discussion of QuickTime is complete without addressing the Advanced Authoring Format (AAF), recently announced by a consortium of companies led by Microsoft. Though AAF incorporates all the right formats, including video, audio, still images, animation, 3-D geometry, and text, the software has no firm release date.

More relevant is RealNetworks' G-2 technology, due in the second half of this year. In addition to high-quality streaming audio and video, G-2 offers support for streaming text, still images, and Flash animations, addressing most QuickTime formats. More important, RealNetworks has proven adept at creating easy-to-use development tools and inspiring third-party application support, both critical

to the success of multiple-medium formats like QuickTime.

Also on the radar screen in the Internet space is Microsoft Net-

Show, with streaming still images, audio, video, and text. These developments make it clear that Apple needs to execute its tools strategy and continue to upgrade its codecs to compete on the Internet. In the CD-ROM world, however—old news to Microsoft and Real but the bread and butter of many corporate training departments—QuickTime stands alone.

QuickTime 3 Movie Player. Price:

free. **QuickTime 3 Pro.** Direct price: \$29.99. Windows requires: 16MB RAM, 7MB hard disk space, Microsoft Windows 95 or NT 4.0. MacOS requires: Direct video MPEG or QDesign; 8MB RAM for 68xx computers, 16MB for Power Macintosh, 7MB hard disk space, Mac OS 7 or 8. Apple Computer Inc., Cupertino, CA; 800-795-1000, 408-996-1010; www.apple.com. Choose 411 at www.pcmag.com/infolink.

Macromedia's Flash, Take 3

Web designers, your job is about to get easier. Macromedia Flash, long a standard for creating low-bandwidth Web animations, is taking a giant leap forward. Flash 3 has sophisticated new tools like morphing and alpha-channel effects and a host of ease-of-use improvements.

Flash, a vector-based drawing and animation tool, combines an illustration program's image control with a multimedia studio's effects. Popular partly because its vector-defined images are small, Flash allows quick loading over Internet connections. The program is also a snap to use for anyone who knows Director or similar programs that use timelines. But don't be scared off if you've never tried multimedia creation. The latest Flash offers better introductory lessons. Neophytes should take only two hours of practice to feel confident enough to design original effects.

And stunning effects they are. We loved the new feature for shape blending—or morphing—which lets you smoothly transform one image to another without setting all the in-between frames. Simply select the first and last frames, then tell Flash to do the rest. If the image doesn't morph just the way you want, use shape hints to give you more direction.

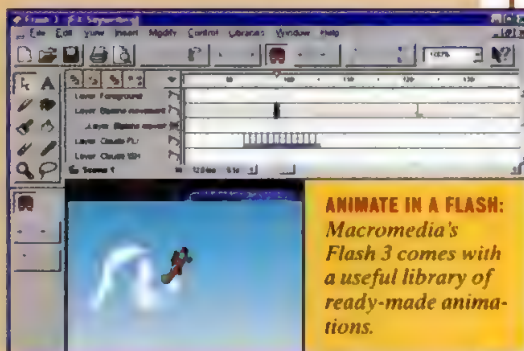
Designers also will welcome the new alpha-channel effects, which let you set an object's degree of transparency. This eliminates the cumbersome workarounds of the past, such as blending an object's color with the background color to give the impression of fading. Now, setting a fade-in or fade-out is simple.

Also welcome are the ease-of-use features like better frame and object selection. Once you've selected an object, the new object selector will display its type, size, and coordinates. The new bandwidth profiler lets you

know how well your movies will download over different connection speeds.

Flash now comes with Aftershock, a handy utility for creating HTML code to display your movie on a Web page. (Aftershock has been available free on the Internet for several months, but it was released too late for Flash 2.) The new Flash also includes a projector, which combines a standalone player and a movie file into one executable file that lets you create movies without a browser.

If Macromedia has its way, you'll soon be seeing a lot more Flash animation online. As it is, you need a plug-in to view Flash, a fact



that often makes designers save Flash for special projects. In April, Macromedia released the source code as an open standard, hoping to get its new SWF format adopted as a Web graphics platform. The company faces competition from Adobe, however, which is pushing its own vector-based format.

Always a top-notch product, Flash 3 takes a giant step up in power and usability. Pick it up and put some movement into your Web site.—Troy Dreier

Macromedia Flash 3. Direct price: \$299, (\$99 upgrade). Macromedia Inc., San Francisco; 800-288-4797, 415-252-2000; www.flash.com. Choose 412 at www.pcmag.com/infolink.



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First Looks

PCs

Celeron Inside

Compaq's affordable Deskpro EP machines bring Intel's Celeron processor to the business desktop.

By Carol Venezia

If you run a small or mid-size business and have to operate within a very tight budget for purchasing new PCs, your processor options are limited. After all, not everyone has the cash to outfit their users with 400-MHz Pentium II machines. So to answer the cries of the budget constrained, Intel has introduced its Celeron CPU; and Compaq Computer Corp. is one of the first to market with a business solution in its Celeron-equipped Deskpro EP 6266 (\$1,220 street without monitor).

THE CACHELESS CPU

Intel's Celeron processor is much like the Pentium II: It's based on the same Deschutes core; it's mounted on a PC board; and it fits into Slot 1. Gone is the L2 cache, however, as well as the black cartridge casing with the funky Intel hologram on the side.

Surrounding this CPU you'll find Intel's new low-cost core logic chip set, the 440EX, which supports a 66-MHz system bus. To keep the cost of the 440EX chip set down, Intel has omitted certain features, including support for ECC memory and dual processors. Also, the 440EX supports only two DIMM slots, or up to 256MB of RAM, and a maximum of three PCI slots.

PERFORMANCE

The Compaq Deskpro EP 6266 that we tested for this review was equipped with 32MB of RAM and an ATI Rage IIC AGP graphics board with 2MB of EDO RAM. We compared its performance to other managed PCs (reviewed in our issue of December 2, 1997, "The Best PCs for '97 & '98") with either 200- or 233-MHz Pentium/MMX CPUs with both 256K and 512K of L2 cache.

The Deskpro EP 6266's Winstone score of 15.3 was about on a par with the average 200- to 233-MHz Pentium/MMX PC with 256K of L2 cache. Compared with 512K cache machines, its performance was about 8 percent lower. Part of the reason for the relatively low scores is the system's CPUmark₃₂ score, which was lower than all four comparison machines.

FOR THE COST-CONSCIOUS

This Deskpro may not have burned up the charts on our Winstone tests, but for its target audience, that may not be such a big deal. Compaq aims this machine at small and medium-size businesses concerned chiefly with price as well as those who want

the latest and lowest-cost technologies as soon as they become available. Unlike other affordable small-business PCs, in its favor, the Deskpro EP provides baseline manageability features, including compliance with the DMI 2.0, Intel Wired for Management, PC98, and ACPI specifications.

The Deskpro EP line also

two clearly marked tabs.

To reorient the system as a mini-tower, of course, you have to reposition whatever is loaded in the three front-accessible 5.25-inch drive bays (our test PC had a floppy disk drive and a 24X max IDE CD-ROM drive). You simply unplug the cables and power connectors, depress a drive-lock button on the side of the drive cage, and pull the drives out. Then you rotate them 90 degrees and put the drives back in the case. The system has guides to help you (making it impossible to put a fixed device in the wrong slot), and all drive bays are numbered. Cables are also

labeled, so you have little chance of mixing them up. Our only minor gripes are that the case thumbscrews are not attached to the panel, so they're easily lost, and that after you rotate the drives there are slight gaps between them.

Compaq backs this machine with its usual three-year warranty on parts and labor, plus

one year of on-site service.

A prefailure warranty backs the 3.2GB Smart hard disk.

If you're looking for an inexpensive PC that delivers all of the basic hardware as well as baseline manageability features, the flexible Deskpro EP is a good choice. But if strong performance on mainstream business applications is a must, you would be much better off with a system that uses a different processor. **Compaq Deskpro EP 6266.** Street price: \$1,220 (without monitor) with 266-MHz Celeron CPU, 32MB RAM, 3.2GB hard disk, 24X max CD-ROM drive, Compaq Netelligent 10/100 Fast Ethernet card, Microsoft Windows 95. Compaq Computer Corp., Houston; 800-345-1518, 281-370-0670; www.compaq.com.



FLIP: The Deskpro EP 6266 is a mini-tower in less than 5 minutes.

includes systems with 266- to 400-MHz Pentium II processors. This wide range should definitely include a CPU to please just about any customer.

DESKTOP OR MINI-TOWER

The most ingenious thing about the Deskpro EP line is its flexible chassis design. Our test machine came configured as a standard desktop, albeit a bit larger than most. But by flipping a few latches and repositioning a couple of drives, we turned the system into a mini-tower in less than 5 minutes. To accomplish this task, take off the side panel after removing two large thumbscrews, then remove the front bezel, which snaps off easily after you depress

High scores are best Bold type denotes first place	ZD Business Winstone 98	ZD CPUmark ₃₂
Compaq Deskpro EP 6266 (Celeron/266, no L2 cache)	15.3	370
Dell OptiPlex Gn+ (Pentium MMX/233, 256K L2 cache)*	15.6	413
HP Kayak XA 5/233 (Pentium MMX/233, 512K L2 cache)*	16.5	458
IBM PC 300PL (Pentium MMX/200, 512K L2 cache)*	16.5	431
Toshiba Equium 5200D (Pentium MMX/200, 256K L2 cache)*	15.5	390

* Reported for comparison (PC Magazine, 12/2/97)

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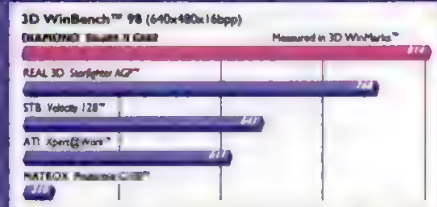
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	Intel® Pentium® II	→	Intel® Pentium® II Up To 450MHz	
Conventional Computer	\$1000 Original Investment	+	\$1000 New Computer	= \$2000
Nexar™ XPA	\$849 Original Investment	+	\$349* Nexar™ Upgrade	= \$1198

*Price to upgrade Pentium® with MMX™ Technology. To upgrade from Pentium® II to Pentium® II 450MHz approx. \$549

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First Looks

LCDs

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NEC's 20-inch MultiSync LCD offers a beautiful image that you can turn on its side.

By Alfred Poor

If you're longing for larger vistas, but your cubicle has already reached its maximum capacity to hold computer equipment, take a peek at the new NEC MultiSync LCD2010 monitor. Prepare yourself for a little sticker shock at its \$6,600 street price, but this 20.1-inch (viewable) color LCD monitor with its high 1,280-by-1,024 resolution has the power to take your breath away on looks alone.

The LCD2010 has a smaller footprint than a typical 15-inch CRT monitor, and at 28 pounds it weighs about the same. The stand tilts and swivels, and you can even raise and lower the whole screen. But things get interesting when you give the display a spin; you can rotate the panel from the traditional landscape to a portrait orientation.

NEC bundles Portrait Displays' Pivot software, which simplifies changing display settings and image orientation. The LCD2010 gives you an amazing amount of space to work with. In landscape mode, you can view two letter-size pages side by side at nearly full size. In portrait mode, you can easily view an entire letter-size page at a larger-than-life size. You won't squint to see details, either; the LCD image is so crisp that 6-point text (just 9 pixels high) is easy to read. The monitor automatically adjusts to the incoming image, so in most cases you won't need to center or resize the screen.

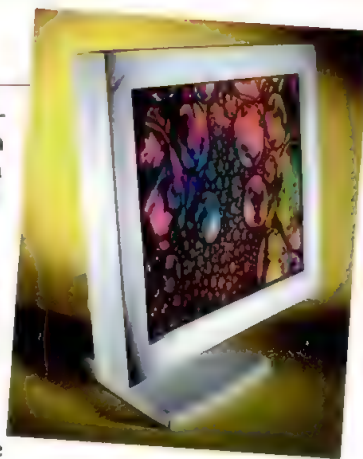
The image quality of the LCD2010 is stunning. Colors are rich and saturated, and there are separate red, green, and blue channel adjustments. The im-

ages were stable, with no moiré patterns or pixel jitter. Amazingly there were no apparent pixel flaws; this doesn't mean that every monitor will be flawless, but given the huge number of pixels on the panel, it's impressive nonetheless.

The only flaw we saw in the images was slight horizontal ghosting in high-contrast images and some faint vertical bright areas from the backlighting. NEC's XtraView technology is designed to provide wider viewing angles than traditional LCD panels. NEC promises a viewing range of up to 160 de-

grees horizontally and vertically, but we couldn't see a practical difference between the LCD2010 and a standard CRT monitor.

The big question is whether the LCD2010 is worth the price. If space, cutting-edge looks, or a clear, crisp, high-resolution display are important issues for you, you may be able to justify the cost. In any case, be careful about taking a casual look at one of these monitors; along with your breath, the LCD2010 can steal your heart. **NEC MultiSync LCD2010.** Street



price: \$6,600. NEC Technologies Inc., Itasca, IL; 800-632-4636, 630-467-5000; www.nec.com. Choose 405 at www.pcmag.com/infolink.

IMAGE-EDITING SOFTWARE

Paint a Perfect Picture

Paint Shop Pro 5 leaves the world of shareware but keeps its ease of use, low price, and great feature set.

By Luisa Simone

With Version 5, Jasc's popular image-editing program Paint Shop Pro makes the big move from shareware to retail. While Jasc will still offer try-before-you-buy downloads from its Web site, the program will also be available in stores for \$70.

Layering is the big news in this release. The ability to vary

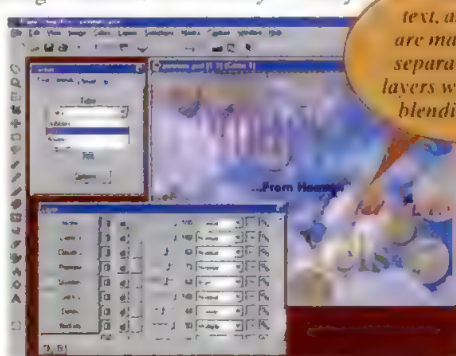
a picture accurately using inches, centimeters, or pixels. And the adjustable cropping tool and free-form deformation tool allow you to tweak the size, rotation, or skew of a selection before you commit to the final edit.

The grab bag of new features includes a Picture Tube brush (which paints with a sequence of im-

ages), import and export of Photo-shop files, and a wider

variety of painting modes for the Retouch brush. Paint Shop Pro also steps up its hardware support with direct access to Kodak digital cameras and tools that respond to pressure-sensitive tablets. The built-in browser helps you find files by displaying thumbnails within a familiar Explorer-like interface.

We did discover a few flaws. Multiple Undos let you revert to an earlier state of your choice, but



The coins, text, and clouds are maintained as separate, editable layers with different blending modes.

LAYERS: Paint Shop Pro's Picture Tube brush created the coins in this montage.

opacity, maintain transparency masks, and choose a blend method for up to 64 layers makes short work of complex compositions. In addition, on-screen rulers and grids let you measure

there's no Redo command. And though you can now produce CMYK separations, you must use old-fashioned color separation tables. Furthermore, you still can't edit a composite CMYK image. Finally, without tangent control handles, the new bezier curve tool isn't very precise.

Surprisingly, Paint Shop Pro does not add any new Web publishing tools. But for a limited time, the program will bundle Animation Shop, which excels at generating color-reduced animated GIF files. Animation Shop offers only rudimentary painting tools, but it does make it easy to import pictures and movies (in GIF, AVI, or Jasc's own MNG format) into a filmstrip. You can jazz up the sequence with transition and text effects.

During testing, Paint Shop Pro had trouble updating the screen as we repositioned layers. Otherwise, we found Version 3.0 of the public beta to be very stable. Jasc is clearly targeting SOHO users, and with a rich feature set and competitive price, we'd call Paint Shop Pro a bull's eye.

Paint Shop Pro 5. Street price: \$70 (\$39 upgrade). Requires: 12MB RAM, 10MB hard disk space, Microsoft Windows 95 or NT 4.0 or later. Jasc Software, Eden Prairie, MN; 612-930-9800, 800-622-2793; www.jasc.com. Choose 406 at www.pcmag.com/infolink.

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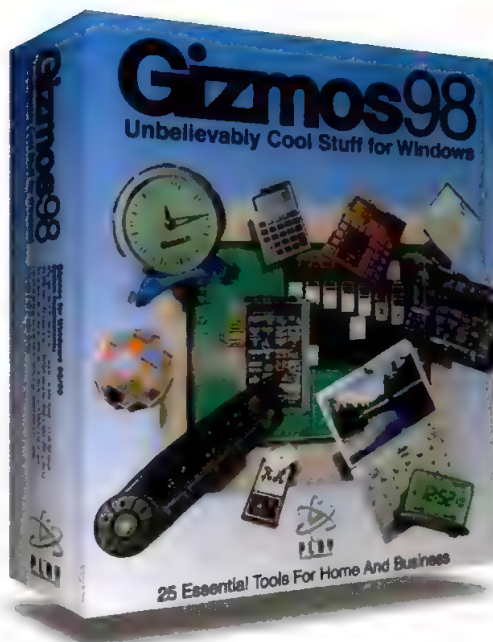


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First Looks

PC CARDS

Road Worrier No More

Xircom's RealPort PC Card adapter is like having LAN and phone jacks built into your laptop.

By Les Freed

If you've ever left for a road trip without the cable adapter for your laptop's modem—or worse, if you've ever broken the adapter or left it in a hotel room—Xircom feels your pain. The company's new RealPort Ethernet 10/100+Modem56 (\$350 street) has no external cables, dongles, gizmos, or flimsy adapters. The RealPort plugs into any Type III PC Card slot and provides standard RJ-45 and RJ-11 connectors for your LAN and phone-line connections.

Xircom has designed the RealPort with mobility in mind. It includes an RJ-11 pass-through jack, so that you connect a telephone and the RealPort modem to the phone line

simultaneously. Four tiny LEDs show Ethernet link and data flow as well as modem carrier and data transmit/receive activity, a welcome feature when you're trying to troubleshoot a hotel-room phone connection.

If you try to plug the RealPort into a digital or PBX line, its protective circuitry kicks in and prevents any damage to the modem. Like all of Xircom's newer modems, the RealPort is approved for use in dozens of countries, and Xircom provides a program that effortlessly configures the modem for overseas operation.

The RealPort is a 10.5-mm-thick Type III PC Card, so it takes up both PC Card slots on a typical business laptop. Some miniature notebooks have only

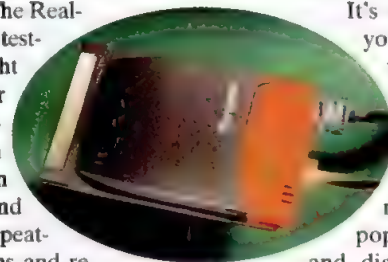
one Type II PC Card slot and can't accept Type III cards.

Unlike most PC Cards, the RealPort has a plastic outer shell, which appears to be designed to compress slightly when inserted into a slot. The RealPort that we tested was a tight fit on our test-bed laptops, which were from Compaq and IBM. But repeated insertions and removals didn't cause any damage to either the RealPort card or the computer.

Under the RealPort's plastic shell, you'll find a full-duplex 10/100 Ethernet card and a K56flex-compatible modem. A no-charge V.90 firmware update will be available in late June (in beta format, as the V.90 standard will not be deployed until August, at the earliest). Xir-

com gets extra points for using the same software drivers as the older Xircom combo card. Users of that card can upgrade painlessly, and corporate IS types don't have to support two driver sets.

It's ironic that if you want to go totally wireless, you'll need a wire. The RealPort can connect to several popular analog and digital cellular phones, but you'll need an optional cable kit to connect your cell phone. The cell-phone cable attaches to the RealPort via a tiny rectangular



PLUG-IN: The RealPort gives you a 56K modem and telephone connectors.

jack beneath the LEDs. **Xircom RealPort Ethernet 10/100+Modem56.** Street price: \$350. Xircom Inc., Thousand Oaks, CA; 800-438-4526, 805-376-9300; www.xircom.com. Choose 407 at www.pcmag.com/infolink.

INPUT DEVICES

Digitize Your Doodles

The CrossPad lets you use a pen and paper to take notes and then store them on your PC.

By Daniel Grotta and Sally Wiener Grotta

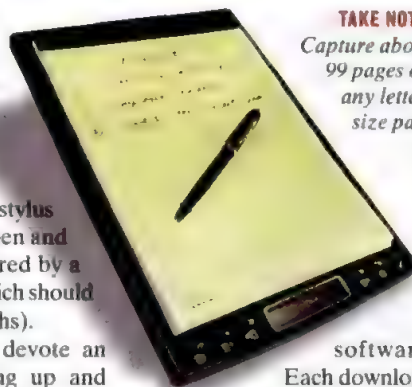
Slack, sophisticated, and potentially indispensable, the \$399 (list) CrossPad portable digital notepad may just become the executive tool of the year. Take notes or make doodles on the CrossPad's paper pad, then connect the device to your PC's serial port, and what you've written is digitized and transferred to your PC as a bitmap file. What's more, IBM's Ink Manager handwriting-recognition software does a credible—though far from perfect—job of translating your scribbles into ASCII text.

The CrossPad weighs about 4 pounds with four AAA batteries (which last about three months) and a 50-page paper

tablet. The included stylus is both a ballpoint pen and a transmitter powered by a AAAA battery (which should last four to six months).

Be prepared to devote an afternoon to setting up and training the CrossPad. The Orientation Guide combines documentation with a tutorial and exercises that train the software to understand your handwriting. You must also learn to navigate by pressing the pen on six different indentations on the bottom of the CrossPad. You must also remember to tell the CrossPad whenever you move on to another page, or it will become hopelessly lost.

To download data, attach the CrossPad to your PC via a serial cable and run the Ink Manager



TAKE NOTE: Capture about 99 pages on any letter-size pad.

software. Each download is saved in IBM's proprietary format (INK). You can save the page as an INK file, which can be printed, faxed, posted on the Internet, or pasted into other documents. Or you can use the handwriting-recognition function to translate your handwriting into text.

As addictive as the CrossPad is, you quickly come up against first-release limitations. It has no graphics-recognition capability, so your crude circles or triangles will remain just that. There's no wireless transceiver,

and attaching a cable for downloads can be inconvenient. Downloads and handwriting recognition can be slow, and having no removable media means that when the tablet's 1MB of ROM is full (it holds about 99 pages), you're done until you download, erase, and start over. There's no place to stow the pen when it's not in use, and if you lose it, a replacement costs \$80 (\$40 if your tablet is still under warranty). As yet, there are no third-party templates for filling out forms.

The CrossPad will appeal to doctors, executives, and others who prefer working with pen and paper, but need to store what they write in their computers. And it's great fun, too.

CrossPad. List price: \$399. Requires: 16MB RAM, 20MB hard disk space, Microsoft Windows 95. A.T. Cross Co., Pen Computing Group, Lincoln, RI; 800-510-9660, 401-333-1200; www.cross-pcg.com. Choose 408 at www.pcmag.com/infolink.

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First Looks

GRAPHICS SOFTWARE

Photo Finishers

New versions of LivePix and PhotoImpact offer more photo-editing tools for businesses and family fun.

By Sally Wiener Grotta
and Daniel Grotta

The explosion in sub-\$100 graphics software means programs that were once lumped together in a single category are now breaking up into specialized areas. LivePix 2.0 Deluxe (\$49.95 list) and Ulead PhotoImpact (\$100 street), for example, both correct and collage photos and feature new Web tools. But LivePix focuses on family fun and projects, while PhotoImpact is, essentially, a business tool.

LIVEPIX 2.0 DELUXE

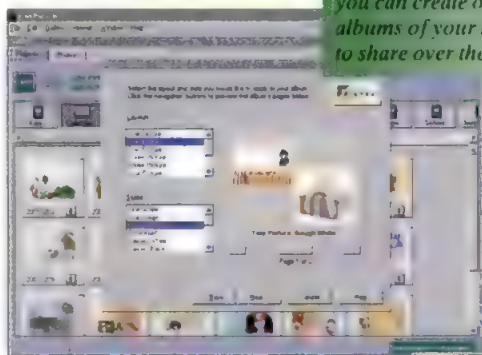
Looking very much like Version 1.0, LivePix 2.0's unimposing interface remains the same, with the addition of a handful of new tools. Installation is also still a breeze, and the pop-up tips help get even the most unsophisticated users up and running quickly. Despite 200 new clip photos and 150 new easy-to-edit project templates, there isn't that much new in this version. But the tools and links for sharing photos via the Internet are, on their own, justification for this new version.

LivePix now has direct links to FujiFilm.net, Kodak Picture Network, PhotoNet, and PictraNet, allowing users to download photos that have been placed in private mailboxes by their film processors. These services also let users upload their pictures to share them over the Web or to have them printed professionally.

The included PictraShare lets you easily create personal, password-protected albums with backgrounds and multiline captions. PictraShare will even check your file formats, and if your photos aren't compressed,

it can convert them to JPEG files without affecting the original files. PictraShare can then connect to the PictraNet Web site and upload your images.

LivePix's e-mail button automatically converts the open picture file to a 120-dpi image and sends it to the included Novita LiveLetter, which in turn packages it as e-mail. LiveLetter is not



With LivePix's PictraShare, you can create online albums of your images to share over the Web.

as intuitive as LivePix, and therefore may confuse some users.

LivePix's new clone tool is easy to control and scalable, and it has pressure-sensitive levels of opacity/transparency. And LivePix now supports Adobe plug-in filters, such as the included light version of Xaos Tools. But there is little else extraordinary in the few new tools or in the enhancements that have been made to the previously existing tools.

Current users of LivePix 1.0 will be delighted with the Web features, the clone tool, and the handful of other additions. For new users, LivePix 2.0 is appropriate if your main interest is having fun and you don't need detailed image editing.

LivePix 2.0 Deluxe. List price: \$49.95. Requires: 16MB RAM, 45MB hard disk space, Microsoft Windows 95. The Live-

Pix Co., San Francisco; 415-908-1067, 800-727-1621; www.livepix.com. Choose 409 at www.pcmag.com/infolink.

ULEAD PHOTOIMPACT 4.0

PhotoImpact is a production tool for businesspeople who need professional-looking graphics right away. Version 4.0 further streamlines the interface, increases the program's versatility and depth, and provides additional tools for Web graphics.

Easy Palette is a good example of PhotoImpact's poli-

cy of bringing power closer to the surface (or basically requiring as few mouse

clicks as possible). Users can now save just about anything into this floating palette, including objects, masks, paths, tool settings, and custom-designed effects. They can all be organized easily (along

with the extensive preset libraries) as thumbnails in editable tabbed pages. Another time saver is the new Quick Command Palette, which automates macro building by recording everything you do and would want to repeat. You can also create hot buttons for frequently used commands.

There's a long list

Type Effects dialogs), the dialogs provide customizable options inside an easy and quick framework of attractive presets. In addition, the effects can be animated with single-mouse-click simplicity by defining key effect settings as individual frames.

The post-processing wizard, which corrects problems in scanned pictures, now offers thumbnail views with which to compare different edit settings. But the thumbnails are too small and can't be magnified without going into another dialog—a time-consuming inconvenience.

For the Web, anti-aliased buttons can be made from any shape selection. The Custom Background dialog is remarkably versatile, and the preview helps users avoid backgrounds that are too complex. The color maps of indexed images are completely editable; you can also choose the one-click optimized index color option, which does a good job.

Though the album can be used to make HTML pages of thumbnails, it doesn't include a link to the source file (which would allow the recipient to see the full-size picture). But Photo Explorer, which used to ship with PhotoImpact, does package the source image with the thumb-

nailed and is a free download from www.download.com for owners of Version 4.0.

PhotoImpact 4.0 provides businesses with pow-

erful yet easy-to-use tools that will give them an edge in the marketplace.

PhotoImpact 4.0. Street price: \$100. (\$69 upgrade). Requires: 16MB RAM, 60MB

hard disk space, Microsoft Windows 95 or NT 4.0. Ulead Systems, Torrance, CA; 800-858-5323, 310-523-9393; www.ulead.com. Choose 410 at www.pcmag.com/infolink.

ARTIST TEXTURES:
PhotoImpact's Artist Textures dialog provides customizable options inside an easy and quick framework of presets.



of useful new features and enhancements in Version 4.0. For instance, in the new Creative Effects feature (which includes the Artist Textures, Transformation, Warping, Particles, Painting, and

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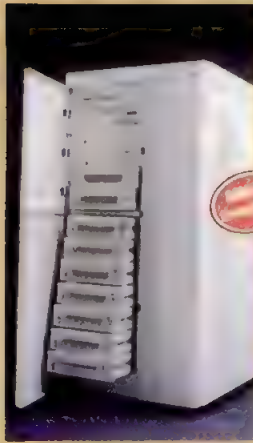
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Second Looks

STARFISH TRUESYNC CE

A PDA for Your H/PC

By Bruce Brown

Like the quest for the perfect PIM (personal information manager), the pursuit of the best possible PDA (personal digital assistant) or hand-held computing device seems endless. Not only do individuals have their own preferences as to devices and software, but they don't want the same functionality at all times—especially if it comes at too great a cost in bulk and weight.

Hewlett-Packard Co. and Starfish Software have devised a unique way to give users added flexibility. Starfish's TrueSync CE (free at www.hp.com/hand-held), loaded on an HP 360LX or



620LX Microsoft Windows CE H/PC, copies calendars, contacts, notes, and to-do lists onto a Franklin REX PC Companion. For our reviews of the HP 620LX and REX, see "The Ultimate Personal Peripheral," March 10, 1998.

With the ability to carry PIM data on the slim REX, which has the bulk of four credit cards, users can have access to key information without carrying the larger

H/PC all the time. You can carry the H/PC with you when you want to access fuller data, run other Windows CE applications, or change and add to PIM data.

You can't edit data on the REX, except to check off to-do list items. It's intended only for storing and displaying data that other devices have created. Also, synchronization does not work both ways with TrueSync CE; each time you copy data from the H/PC onto the REX, the card's previous information is replaced.

TrueSync CE configuration screens let you select calendar, contact, task, and memo data for

synchronization. You can further restrict the amount of data included in each record to conserve REX storage space. In our testing with minimal contact data (names and phone numbers), we were able to synchronize up to 2,234 contacts to a REX card.

HP has an exclusive agreement with Starfish that lets it use TrueSync CE with its H/PC models. The company will burn the software in ROM and bundle the program in the 360LX and 620LX models this month. HP has also said it will bundle the software with any future Windows CE H/PC models.

If you want it all, including the choice of carrying a reasonably powerful hand-held computer or just a card-size device for personal information, TrueSync CE will give you ultimate PDA flexibility.

SECOND LOOKS ONLINE

Love That Pilot!

By Nancy Hirsch

People just love to voice their opinions. So PC Magazine Online recently set up a Second Looks discussion area to let visitors to our Web site do just that (www.secondlooks.com), and they've been bringing up issues they've had with products we've reviewed ever since. That is, until we asked them to discuss their experiences with 3Com's PalmPilot. Practically everyone had something positive to say about this device, and more often than not, comments were along the lines of "I don't know how I lived without one" and "It is easily my all-time favorite computer product."

And what about Microsoft Windows CE? Most PalmPilot users seem to think that Microsoft doesn't stand a chance. In the words of one visitor to PC Magazine Online: "A keyboard to control a palmtop is like a steer-

ing wheel to control a toaster."

Instead of listing problems with their PalmPilots, our Web site visitors were eager to share tips on where to find useful third-party software. One such program is AvantGo's AvantGo Desktop and AvantGo Web Client (\$99 direct; www.avant-go.com), which can synchronize and update information from Web or intranet pages on your PalmPilot. AvantGo's compression technology lets you grab a lot of data from the Web and store it on your PalmPilot, without taking up a lot of space.

If making quick notes to yourself more useful, Actioneer (\$19.95; www.actioneer.com) automatically adds tasks to the appropriate applications in your PalmPilot. For example, if you jot down "Call Bob on Fri. at 2," Actioneer will search for keywords and add this to your To Do list for Friday as well as put it

on your schedule for 2:00. If you find yourself away from your PC, but still need to print information from your PalmPilot, StevensCreek Software has a solution. Its PalmPrint (\$19.95; www.stevenscreek.com) lets you connect the PalmPilot cradle to a printer or another PC so you can print directly from your PalmPilot.

There's also plenty of free software you can download to your PalmPilot. Want to read *Great Expectations* on your PalmPilot? Just download the freeware AportisDoc (www.aporis.com), which is a file format that lets you store and annotate large amounts of text without taking up much of your PalmPilot's memory. Then head to www.macduff.net to check out its impressive lending library of

titles you can download for free. There's even more at www.memoware.com, where freely downloadable content ranges from the arcane (a list of common phobias or a guide to

estimating the weight of a fish based on its length) to the truly useful (*Roget's Thesaurus* and various cities' subway maps and schedules).

There are plenty more Web sites of special interest to PalmPilot lovers, and a good place to start is the PalmPilot Web site itself (www.palm.com). Here you'll find more add-ons as well as links to other independent PalmPilot Web sites. Also, check out ZDNet's Software Library (www.hotfiles.com) for more of the latest downloads.

SECOND LOOKS MAILBOX: Tell Second Looks about your experiences with computer products. Contact Carol Venezia at cvenezia@zd.com.



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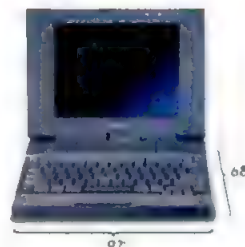
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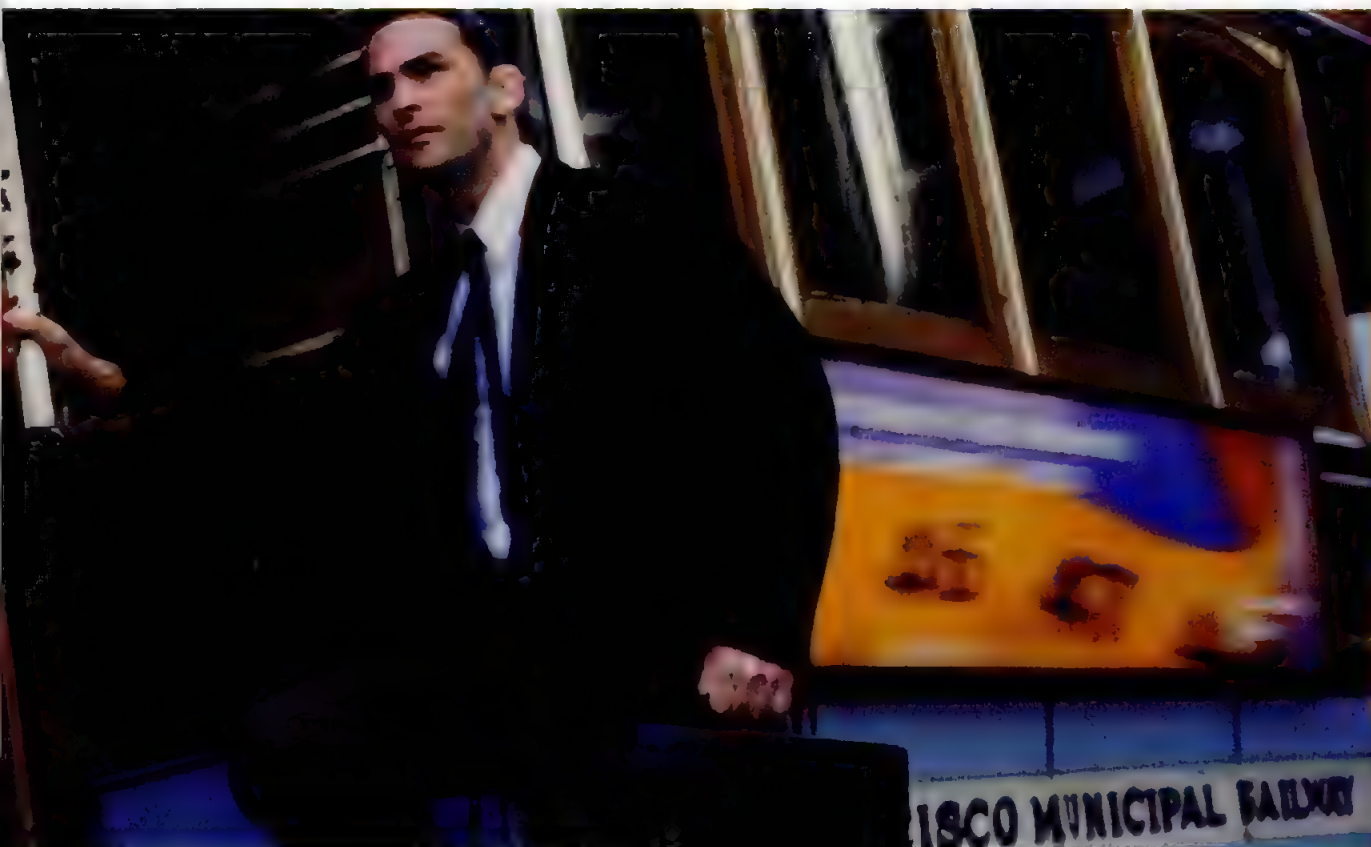
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Driving Drunk

We're in a parking lot behind the high school. A hundred or more kids are waiting their turns to drive a perky white Dodge Neon through a course of pylons and chalk. The instructor will ask the kids their weights and tell them how many "drinks" they've had,

and she'll program that information into the laptop computer mounted on a bracket in front of the passenger seat. They'll drive one lap, and the instructor will hit a key as they begin the second. Based on projected blood alcohol levels, the computer will then insert delays into the steering and braking systems to simulate the slowed reactions they would have had if they'd actually had the drinks.

A student negotiates the first turn successfully but goes a little wide in the second. She overcompensates and mows down a few pylons, much to the delight of her classmates. The instructor encourages her to maintain speed, and she picks it up as she approaches an intersection with a couple of radio-controlled plastic silhouette "children" nearby. A "child" pops up suddenly, as if running out from between parked cars or preparing to dash across the intersection. The student hits the brakes, but her computer-dulled reaction time causes her to slide through the intersection, coming to a stop a car length beyond the "child." She moves the car cautiously back to the starting line and gets out with a sheepish grin.

One of the guys hops in, full of bravado, intent on showing everyone that he won't be fooled by the car's tricks. He takes the first lap briskly, a skillful, natural driver. On the second lap, he clips a pylon on the first turn but continues at the same pace as for his first lap. His second and third turns are successively worse; by the time he's halfway around the course, he's totally out of control, heading for the sawhorses and the parked cars beyond. The instructor hits the safety brake on her side of the car, which not only stops it but cuts the engine. Chastened, the student brakes well before the intersection and creeps back to the starting line.

Chrysler Corp. has three of these simulators on the road; each team does 120 events per year. They've had over 1 million participants so far, and they average 500 new ones per day. Mothers Against Drunk Driving cosponsors the simulators on a national level, with additional funds provided by local agencies. In our case, our town's Municipal Alliance Committee (funded by the New Jersey Gov-

ernor's Council on Alcoholism and Drug Abuse) brought in the simulator, and local high schools paid a nominal fee for their students to attend.

The modifications to the Neon are elegantly simple: The laptop sits in front of the passenger/instructor and is

wired to a custom-made digital-analog board in the glove compartment. The computer factors in the extra reaction time, watches what the student does with the wheel and the brake, and delays the students' actions just long enough to confound them. A computer-controlled clutch in the power-steering system cuts off the power assist, rendering the car sluggish and hard to turn, then switches it back on, inviting overcontrol. A solenoid valve in the braking system presents a firm pedal to a student's foot but prevents the pedal action from getting to the brakes for a long, heart-stopping moment. "We had this idea years ago," said one of the instructors, "but the laptop computer made it possible."

The kids, understandably, don't share my interest in the technology, concentrating instead on keeping the obstreperous little car between the orange cones. In my own turn behind the wheel, I am less disturbed by the steering than by the brakes. Not being able to stop, even for a moment, is terrifying. I now understand their shouts and shrieks at a gut level. It's a convincing demonstration. Take a look at our day at www.billsbest.com/thdrunk.html.

Still, this simulation could be even better. For instance, if the steering arm were connected to the wheels through a computer-controlled hydraulic system, the car could be programmed to drift, even when you think you're holding the wheel steady. A too-quick movement on the wheel could cause overreactions. Going further, special drunkenness-simulating glasses, called Fatal Vision (www.excel.net/~scobb), disorient your vision and balance to the point of nausea. Could an electronic version work under computer control to make the drunk-driving illusion more complete?

If applied technology like this convinces one more kid not to drive drunk, then it's worth every penny. **PC**



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The Big Microsoft PR Ploy

Microsoft has turned its head-to-head with the United States government from a negative into a positive in a vain attempt to boost the fortunes of Windows 98. Evidently, Microsoft believes that when you have lemons, you should make lemonade.

Microsoft in the past has done a marvelous job of manipulating the press each time it has released a new version of Windows—especially Windows 95—with gala events worldwide, elaborate press coverage, fawning reviews, and publicity stunts such as the banner hung from the giant tower in Toronto. Despite being top-heavy with PR agencies (Edelman, Hill and Knowlton, Shandwick, and Waggener-Edstrom, to name four) the company was unable to get a buzz going about the launch of Windows 98. Microsoft had to leverage the massive press coverage surrounding the Justice Department's antitrust suit against Microsoft.

I was tipped off that the battle with the DOJ was being turned into the basis for a publicity stunt by two pieces of evidence. First, the attorney general of Connecticut, Richard Blumenthal, speaking on "Charlie Rose" on May 18, said he was baffled by the events of the previous week. Apparently, Microsoft had said it would negotiate with the DOJ and states Thursday and Friday if they didn't file their complaints on that Friday. According to Blumenthal, as a carrot to forestall the Friday filing, Microsoft offered at least to give up the Microsoft start-up screen and let PC manufacturers put whatever they wanted there. But when Microsoft officials got into talks, they not only did not compromise but actually pulled back on the offer. The talks collapsed on Saturday, forcing the lawsuit filing to happen on Monday. This meant Microsoft would have the whole week to get publicity for itself and Windows 98. If the filing had taken place on Friday, much of the impact would have been lost over the weekend.

The scheme becomes clearer when you read the June 8 issue of *Fortune*, which contained a last-minute interview with Bill Gates. According to the writer: "As *Fortune* went to press lawyers from both sides were huddling in Washington." This might indicate that the interview took place shortly before Microsoft stalled the Friday showdown. But in the interview, Gates seemed to have his mind made up that this whole suit was going to court, "because in a court people have to tell the truth." The rest of the interview is

Bill moaning about how Microsoft is for innovation and the government is against it.

Then there is the word *innovation*. A key word, it's showing up too often in too many places in association with Microsoft and Windows 98. Obviously, the Microsoft spin doctors

are trying to associate the word *innovation* with Windows 98 in the minds of the public. This is cute, since there is very little innovation in Windows 98. Everything in the OS is either a geegaw, a bug fix, or some new support, such as that for USB.

Fortune magazine played right into the hands of Microsoft as usual, with a follow-up piece slamming DOJ Antitrust Division chief Joel Klein. It had quotes from Washington senator Slade Gorton, who—parroting the Microsoft line—said the government is trying to "arrest the development of a new generation of innovation." *The Wall Street Journal* gave Gates even freer rein, with an op-ed by Gates titled "US v. Microsoft: We're Defending Our Right to Innovate." Innovation, it seems, is now a right.

The "innovation" theme apparently began shortly after Microsoft was forced to hide the IE icon in Windows 95, in a deal struck with the DOJ on January 22, 1998. Five days later, on January 27, the day he visited the San Jose Museum of Innovation, Gates first used *innovation* in association with the case. The word must have jumped out at him from the museum sign. He described the DOJ case as "the government versus innovation."

Innovation is not found in any previous press materials or speeches. Gates, though, immediately jumped on the term. This was epitomized by his "leaked" February 2, 1998, memo to employees. There he complains about his competitors and the government, saying, "If Microsoft is to fail, let it be because we failed to innovate, not because our innovations were outlawed."

Unfortunately, the association of innovation with Windows 98 is too little too late. The week of expected news stories after the Monday complaint was filed petered out by Thursday of that week. It will take more than these cheap tricks to duplicate the success of Windows 95.



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Inside Track

What will **adding still more instructions** to Intel Pentium chips accomplish? Not much, according to the companies that make graphics accelerator chips. As many of you know, the Katmai Pentium II will add **70 new instructions**, supposedly geared for 3-D. But it appears to be too little, too late, as the graphics accelerator folks blow past all this with newer **geometry engines** that let cheaper processors do even more. Currently, 3-D accelerators have optimized rasterization specifically for cool games.

In other words, all the 3-D work that the CPU vendors are doing is going to be **blown out of the water** by the graphics accelerator folks, no matter what they tell you. Although the general-purpose CPU has carried us for decades, it has suffered, traditionally, when compared with a system that simply adds a DSP chip or other helper chips to the architecture. This is unlikely to change. All the 3-D stuff being put on the CPU will be a **generation behind**. The kicker is that the newest hardware geometry engines being proposed appear to be a little more costly than the last generation of accelerators. On the Intel side of the ledger: At least the company is developing a **Katmai compiler plug-in** for Visual C++. With the original Pentium MMX technology, programmers had to **hand-code everything in assembler** to take advantage of the new instructions. Assembler is becoming a lost art.

Question for Readers Dept.: Why do some new, faster machines die for no reason, when they're not even being used? Not failing but **just dying** and requiring a reboot. (Yes, I use conditioned power.) If this has happened to you, send me a note at deadmachine@dvorak.org, and I'll see if something weird is going on. The **most reliable machine** I've had over the past couple of years has an AMD/233 CPU. I've had it running on a network for months on end without ever needing to reboot. Rich Cannizzo, who runs the site Toocool.com as well as Dvorak.org, runs an **AMD/233 under Linux**, and it's never gone down, ever, except during maintenance or a security breach.

Microsoft Watch: Microsoft is now promoting something it calls *NTE*, or Windows NT—Embedded. It hopes to put this new OS, described as a **slimmer and sleeker** version of Win NT, on routers, switches, PBXs, and washing machines, I suspect. When I see such supposedly slimmed-down OSs coming from Microsoft, I wonder why the company doesn't **move them to the desktop**. The case in point is Windows CE. If Windows CE is compact and fast, why not port it to a desktop system? What **does Win CE not do** that prevents this? It sounds to me like the ideal OS for a sub-

*If Windows CE is
compact and fast, why
not port it to a
desktop system?*

*What does Win CE not do
that prevents this?*

*It sounds to me like the
ideal OS for a
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\$500 desktop. I suspect Win CE is closer to being crash-proof, for one thing. People who buy hand-held computers are **not going to tolerate crashes**. Have you ever had a calculator crash on you? My PalmPilot has never crashed. You can be sure Win CE won't crash, either. As for Windows NTE: It directly affects VenturCom, a company that already developed, under license, an embedded version of Win NT. VenturCom continues to work on a real-time Win NT (as do others) and licenses its Win CE tools to Microsoft. Whatever the case, look for **more and more offshoots of Win NT** in the year ahead.

There Goes the 15-Pin Connector Dept.: I give the 15-pin VGA connector maybe another year, two at the most. This is because VESA

and a group of computer companies are trying to **promote new connectors** for monitors and display cards. The problem is that we'll probably see various new connectors on the market at the same time, and if you choose the wrong one you may end up with a white elephant (although I suspect there will be adapters to correct this, but maybe not). This is particularly important for those who have wisely chosen to move to a **21-inch monitor**, knowing that you can keep it through many systems, which makes the amortized cost rather low. But you don't want a 21-inch monitor with a weird, unusable plug on the back. Until this shakes out, stick with the 15-pin VGA plug. While it may be on the way out, you can be sure it will supported as a **legacy connector**, much like the clunky SCSI connector.

The digital-TV battle is getting dirty again. The U.S. government has been trying to push digital TV into the market. **The reasons for this elude me; TV seems fine to me as it is.** I can see the picture okay. The resolution seems fine. What do I get out of spending more money for higher resolution? My theory is that the extra money spent on the production side will just be taken from the writers' pockets, making the **overall product stink**. Meanwhile, the battle between progressive-scan and interlaced displays has heated up again: John Malone has joined forces with the computer folk, ABC, and Fox on the side of **progressive scan**. Everyone else wants interlaced. The government wants everyone to do everything, no matter what the cost. You'll note that the progressive-scan folks are the ones most likely to benefit from computer technology. Disney is going into the Web in a big way, TCI is heavily involved with @home, and Fox—well, uh—is Fox.

Nobody has explained to me exactly why we need HDTV in the first place. The argument is that we'll fall behind other nations. In what? **I watch too much TV already**, and watching more seems to be the epitome of falling behind. **PC**

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Win 98's Big Display Secret

One of the sillier contests in predictology this spring has been the “Will Windows 98 be a success?” nonsense. With the flurry of rulings, filings, and settlement talks and Microsoft’s last-minute delay in shipping Win 98, the focus has shifted to the ethics of

innovation. Lawyers, especially those employed by government (any government), see these things a little differently than you and I. We think innovation is good; they think it’s dangerous—and a rich opportunity for publicity.

I can’t tell you what the Department of Justice will find to complain about next, or what state attorneys general eager to find their next Big Tobacco will come up with. But I can tell you what I think about this silly “Win 98 success” stuff and, more important, what’s in Win 98 that I think will make a lot of *PC Magazine* readers join the ranks of upgraders over the next few months.

A success? *Of course!* With Win 98 preinstalled on more than half the PCs sold this year (Windows goes in well over 90 percent of all new PCs), with those preinstalls beginning in June, and with both the velocity of this market and the “Christmas-quarter” sales bulge near the end of the year, Win 98 may be on 65 to 70 percent of this year’s PCs. Windows 98 is automatically a success.

The real test for success is in the upgrade market. Here, the counting is a little trickier.

My guess is that something over 6 million PCs will be upgraded to Win 98 this year, and another 10 million during 1999. That wouldn’t be as fast a start as that of Win 95, which sold 8 million copies in its first four months, but two factors are working against that kind of gold rush. Neither is a negative for Microsoft or for PC users.

First, this is a far less revolutionary jump than was the one to Win 95. It’s important—and you should make the leap if you want to stay in the Win 9x camp, as you’ll see—but it’s not as big a deal as Win 95 was.

Second, many upgraders will jump to Win NT 4.0 this year or Win NT 5.0 next year, instead of moving to Win 98. Win NT is better suited for some uses and users, so why should we worry about people who take that path?

(For that matter, why should Microsoft worry? Upgrades to Win NT bring in three times the revenue of upgrades to Win 98!)

Win 98’s going to be a success. The question is: Should you upgrade?

If you want to stay in the Win 9x world, moving to Win 98 buys you a little more speed and a lot more stability. The speed improvement is sometimes slight and never more than modest, in my experience with betas, but it is there. More important is the increased stability in Win 98.

You’ll spend less time shutting down individual apps gone awry. You’ll have fewer memory-based problems. *I think the speed and stability improvements alone are worth \$90.*

What else? Look at two important features of Win 98: better USB support and especially multimonitor support. USB devices are still thin on the ground, and yes, you can get them working with Win 95, with the right patch or a late OEM version. But support is cleaner in Win 98; even if you aren’t much interested in USB devices today, I can promise you will be by this time next year.

Multimonitor support is my favorite Win 98 feature. It’s not for everyone: The space and cost requirements make multiple monitors impractical for many PC users. And some people simply don’t need multiple monitors and wouldn’t want them even if they were free. But for many of us, multiple monitors make a great deal of sense.

Multimonitor support has been weak in Win 98 betas. Microsoft hasn’t supported enough video chip sets, and drivers have been flaky. But in the latest betas, support is wider and much more

stable. Remember that I’m writing this before the release of the final Win 98 code, so things will change and your mileage will vary.

Strictly speaking, you don’t have to have Win 98 to use multiple monitors on a Wintel machine. STB has made a succession of multiple-monitor-capable video cards that have worked well, especially with Win NT 4.0. But I want multiple-monitor support in the OS, and now it’s here.

Right now, I’m sitting at a 21-inch Nokia monitor, with 17-inch monitors on either side of the big one. I’m using Microsoft Word 97 on the Nokia; my e-mail program is running on the left-hand monitor, and my Web browser is



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running on the right-hand display. Sometimes I bring up a display of real-time quotes on one side. When I'm doing Web design, I run Net-Objects Fusion in the center, with Photoshop (and instant scanner access) on the left and a browser on the right. Or I have Navigator on the left and IE on the right, for quick previews of pages in progress. And so on.

You can easily get hooked on this way of working. Yes, you can flip to alternate windows on a single display, but that's not nearly the same thing.

Using multiple monitors sounds expensive, but it needn't be. I've tried all sorts of combinations of flanking monitors, and frankly, a couple of small, cheap 14-inch or 15-inch displays work almost as well as 17-inch units. Bliss would be 15-inch LCDs on both sides, but at \$1,500 or so each, that solution's too rich for my blood.

You may already have an older monitor or two that you're not using, stuck in a closet. If not, you can find decent 15-inch monitors for reasonable prices—as little as \$100, if you're willing to gamble on a used display.

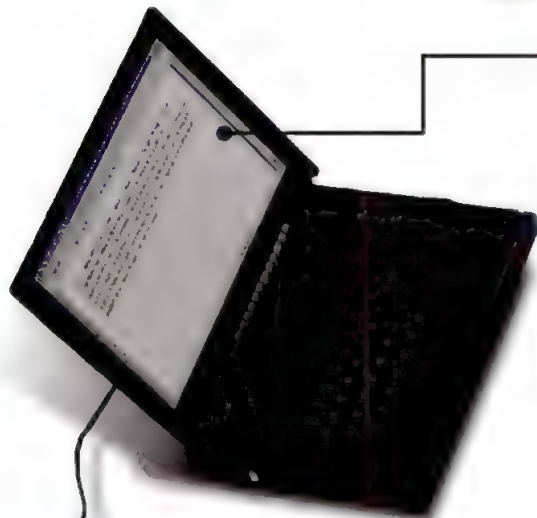
There is significant cost in the additional display card or cards. In theory, Win 98 multi-monitor supports mix-and-match video cards and displays. But in my experience, although you can put whatever you want on the ends of the VGA cables, you'll want the same basic chip set—and maybe the identical board—that you have in your PC.

I've had great success using STB cards for multimonitor setups. I like the performance of the 128-bit RIVA chips on the STB Velocity 128 boards, but Win 98 betas haven't supported the RIVA chips. (I expect to see support for this in the shipping version.) So I've been using slightly older S3 ViRGE GX-based cards without a problem. STB can save you a PCI slot, a couple hundred dollars, and a lot of grief with its latest multiple-monitors-on-a-single-card Velocity 128 Pro RIVA-based boards.

(By the way, with relatively recent motherboards, I haven't had any problem with PCI interrupt sharing using these cards—a good thing, given the shortage of IRQs in most new machines.)

If you have the space and some extra money, I think you'll find working with two, three, or maybe even four displays on your Win 98 PC an absolute delight. This is not for everyone, true, but it's the new feature in Win 98 that I think serious upgraders will love most. **PC**

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How to Get to the Head of the Class

When it comes to buying PCs, two paths lead to happiness. Buy direct, and you'll get better support. Buy retail or through a reseller, and you'll get a desktop PC that doesn't break as often.

That, ever so broadly, is what *PC Magazine* subscribers told us in

our annual Service and Reliability Survey.

Traditionally, the July issue of *PC Magazine* has been devoted to our description of the state of the art in computers, notebooks, and networks ("The Perfect PC") and to your telling us how you rate the service, support, and reliability of the PCs and notebooks you've used in the past two years ("Service and Reliability"). As computers become more similar in their components and performance, the biggest differentiators may be how they're built and how they're supported.

Among desktop PCs, three vendors earned a grade of A: Dell, HP, and IBM. Among notebook PCs, two vendors earned an A: Dell and Gateway. Here's my take on our survey of 17,000 *PC Magazine* subscribers.

The grading system (in which vendors can earn an A, B, C, D, or E) comprises four key questions: satisfaction with reliability, with repair, and with tech support and the percentage (frequency) of units needing repair in the past year. A vendor had to be ranked above average on all four points to earn an A. Repair frequency was the toughest nut to crack. Of desktop vendors, 6 of the 25 were above average—Dell and 5 retail/reseller-oriented vendors: Apple, Compaq, HP, IBM, and Sony. This question kept direct sellers Gateway, Micron, and Quantex from earning A's; they were all ranked average on this one question only and above average on the three satisfaction questions.

By comparison, the satisfaction-with-repairs question cost Compaq and Sony their A's; they were ranked above average on everything else. Digital missed an A because it was ranked only average on the satisfaction-with-repairs question and on the repair-frequency question.

Sony was barely a year into the U.S. market at the beginning of this year, when the survey was taken. Based on its showing, Sony is a force to be reckoned with. If you read the numerical breakouts, you'll see Sony's repair-satisfaction score was 8.0 (on a 1-to-10 scale), and the average was 7.4. Sony was ranked as average because average means, to *PC Magazine's* statisticians (who used

t-tests), either statistically average or (in Sony's case) not statistically different from average. When you have fewer responses, our wizards say, you need to be further from the average than vendors with more responses to rate above average or below average. Sony had 100 responses; Gateway had 2,414.

At the other end of the spectrum, three key vendors are in trouble based on our responses: Acer, AST, and Packard Bell all received D's. Packard Bell pumped money into a state-of-the-art tech-support facility outside Salt Lake City, but our subscribers don't see much benefit. The company starts out building PCs as rugged as most: It's ranked as average on recent repairs. But Packard Bell falls down when you look for help, and it's ranked as worse than average on the three satisfaction measures. Packard Bell has the worst rankings of any still-active vendor for time on hold (19 minutes), needing more than one call to resolve problems (41 percent of respondents), and getting a runaround from tech support (32 percent). AST was second-to-worst in time on hold (17 minutes). Acer's scores contrasted with those of Packard Bell on the four key measures. The company's support is adequate, but something is amiss with the build quality, because it's the only vendor to receive a below-average ranking for repair frequency.

Among the 15 notebook vendors we graded, you don't see any broad direct-versus-retail/reseller trends. Perhaps this is because, with a handful of exceptions,

notebooks are built for (not by) the vendors, and what matters most is how much QC the vendor requires in the factory. Notably, the top three sellers—IBM (B), Toshiba (C), and Compaq (D)—are all only average on repair frequency, and Compaq was one of only two active vendors to be ranked worse than average on satisfaction with reliability.

Of the 16 measures we report, the one I turn to first is the one that's most subjective: Likelihood of buying again. It's a good summary of how users feel about their PCs, whether the vendor is on target with price, and whether users feel the vendor has a viable future. Vendors who've slipped on this measure are in a world of hurt. **PC**



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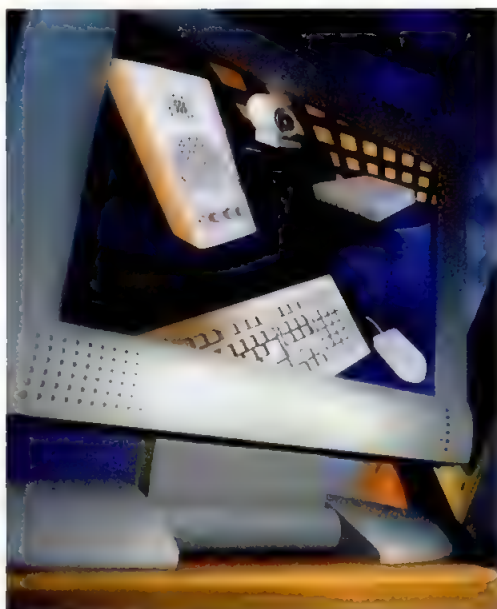
SPECIAL
ISSUE

The Perfect PC

Whether you're looking for a desktop, portable, server, network, or component, you'll find the perfect one in the following pages.

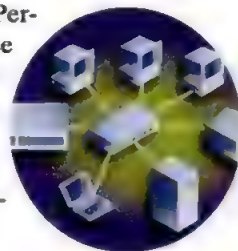
Illustrations by Visual Logic /Joe Ski;

Network diagrams by Mark Tyner



Over the past few years, the concept of the Perfect PC has changed dramatically. Not too long ago, the phrase conjured up images of the biggest, fastest, highest-technology desktop PC that any of us could reasonably imagine. For many people, this "Dream Machine" is still the Perfect PC.

But an interesting thing has happened to the Perfect PC over the years. Instead of one Perfect PC, we now have multiple examples. For some, the Perfect PC is still that high-performance screamer. Others just want an affordable workhorse for use in the office. Still others want a new machine for the kids to use for their homework, or as the center of a new home-theater setup. Some peo-





ple are looking for a portable computer they can take with them. Others may need a server that will tie together all the computers they have.

In this, our seventh annual Perfect PC issue, we look at all these different kinds of PCs and show you the features and components we think you should be looking for in each category. In the sections that follow on desktop computers, desktop components, portable computers, and networking products, *PC Magazine* editors and the staff of PC Magazine Labs have created lists of equipment they think make each machine "perfect" for particular tasks and specific markets.

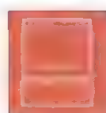
We follow this up with the results from our annual Service and Reliability study, through which we let our readers tell us how satisfied they are with machines from different vendors. As usual, we looked at both desktop and laptop computers, and we found the results interesting and a bit surprising. We also looked at different kinds of printers and at five different categories of software: operating systems, office application suites, Web browsers, Internet e-mail clients, and corporate messaging solutions. The results are bound to be controversial.

You'll also find a tear-out worksheet you can use for comparing our recommendations and your options for multiple systems, so you can find the machine that is perfect for you.

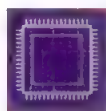
We have noticed that the gap between the Perfect PC and the one we actually use seems to be closing every year. Of course, new technology has made both the machines we have and the machines we want more powerful each year. With technology moving so rapidly, it takes less time to move from the ideal to the practical, from the things we want but can't afford to the products we buy in quantity. In many ways, the machines we have on our desks now are pretty close to the Perfect PC of last year. They may even be better.

Of course, no machine is ever really perfect. We always want more speed, more stability, more features. We're always seeking something new. But no one ever said perfection is easy.

— Michael J. Miller



Desktops Look for our perfect dream, home, and office PCs as well as our perfect upgrade. **102**



Desktop Components Get more information on your CPU, graphics, storage, and multimedia subsystems. **136**



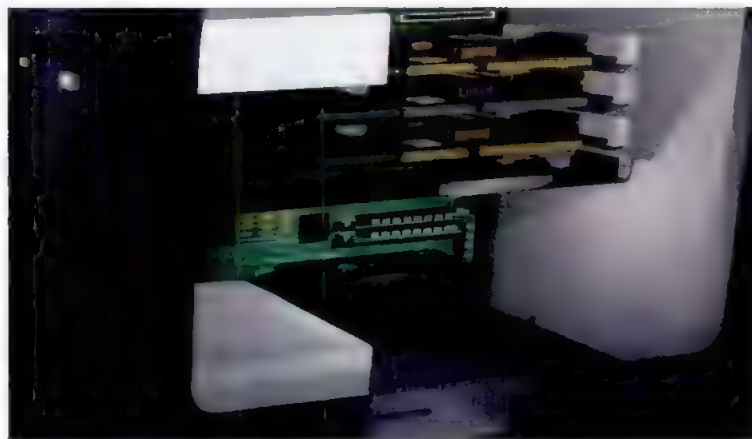
Portables Check our recommendations for the perfect high-end, value, and lightweight notebooks. **178**



Networks Find out which mix of components and connection types will give you the fastest network. **192**

Plus: 1998 Buyers' Guide In this pull-out guide, you'll find our recommendations for different systems and worksheets for your selections. **125**

Readers Rate Vendors See our annual reader survey on support satisfaction with PC, printer, and software vendors. **219**



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Dream PC

Want power? From a 400-MHz Pentium II-based machine to a brilliant 20-inch LCD flat panel, you've got it.

By Anush Yegyzarian

Our dream PC isn't meant for typical office applications or for users on a tight budget. The system is built to bring you the best a desktop PC can offer—and then some. It begins with Intel's latest processor, the 400-MHz Pentium II, which is the third iteration of the Pentium II chip. Not only does this incarnation boast the fastest Intel-compatible processor speed, but it and the 350-MHz Pentium II feature a faster, 100-MHz system bus. This is the first time since the debut of Pentium, which has a 66-MHz bus, that Intel has raised system bus speed. If that's not enough power for you, expect 450-MHz versions of the chip to be released by year's end.

If you're looking for a workstation-class processor, wait for the Intel Xeon, which will debut shortly. Xeon, a Slot-2 CPU, will offer not only the 100-MHz bus but also 512K or 1MB of L2 cache running at full processor speed. The Pentium II's L2 cache runs at half processor speed.

PERFECT SUBSYSTEMS

In a truly perfect world, one graphics card would be equally adept at 2-D and 3-D graphics. Though there are many cards that handle both fairly well, that's not enough for our dream PC. To get the best performance, we recommend that you invest in two graphics cards—one optimized for 2-D, the other a Direct3D-based card for top 3-D performance. The latter should run



on your AGP bus; each card should have at least 8MB of RAM. Direct3D is now readily available; most games support it, and we expect business applications such as spreadsheet programs and presentation software to follow shortly.

You will get an OpenGL mini client driver with most Direct3D cards. If you plan to use true, heavy-duty OpenGL applications, such as LightWave or Softimage, you'll need to replace the Direct3D card with a top OpenGL card, which has the full ICD (installable client driver), for more efficient performance. The OpenGL

card should have 8MB to 16MB of RAM.

There is no shortage of storage these days. You should have two 14GB 7,200-rpm Ultra ATA disks to provide lots of space. Though 10,000-rpm IDE disks are becoming available, such drives (like their SCSI counterparts) are noisy. If 14GB isn't enough, look for the new 17GB disks. Check your BIOS setting to make sure that Ultra ATA is enabled in your PC to get the maximum benefit from your disk.

LCD panels have made technological progress and come down in price. Some 14-inch panels are hovering around the \$1,000

mark, and even the 20-inch ones are more affordable—down from \$8,000 to \$6,500. We recommend a 20-inch LCD: It will give you a slightly larger viewing area than 21-inch CRTs and provide a brilliant picture. Many 20-inch LCDs display only at 1,280-by-1,024 but may let you rotate the screen 90 degrees, giving you a portrait panel.

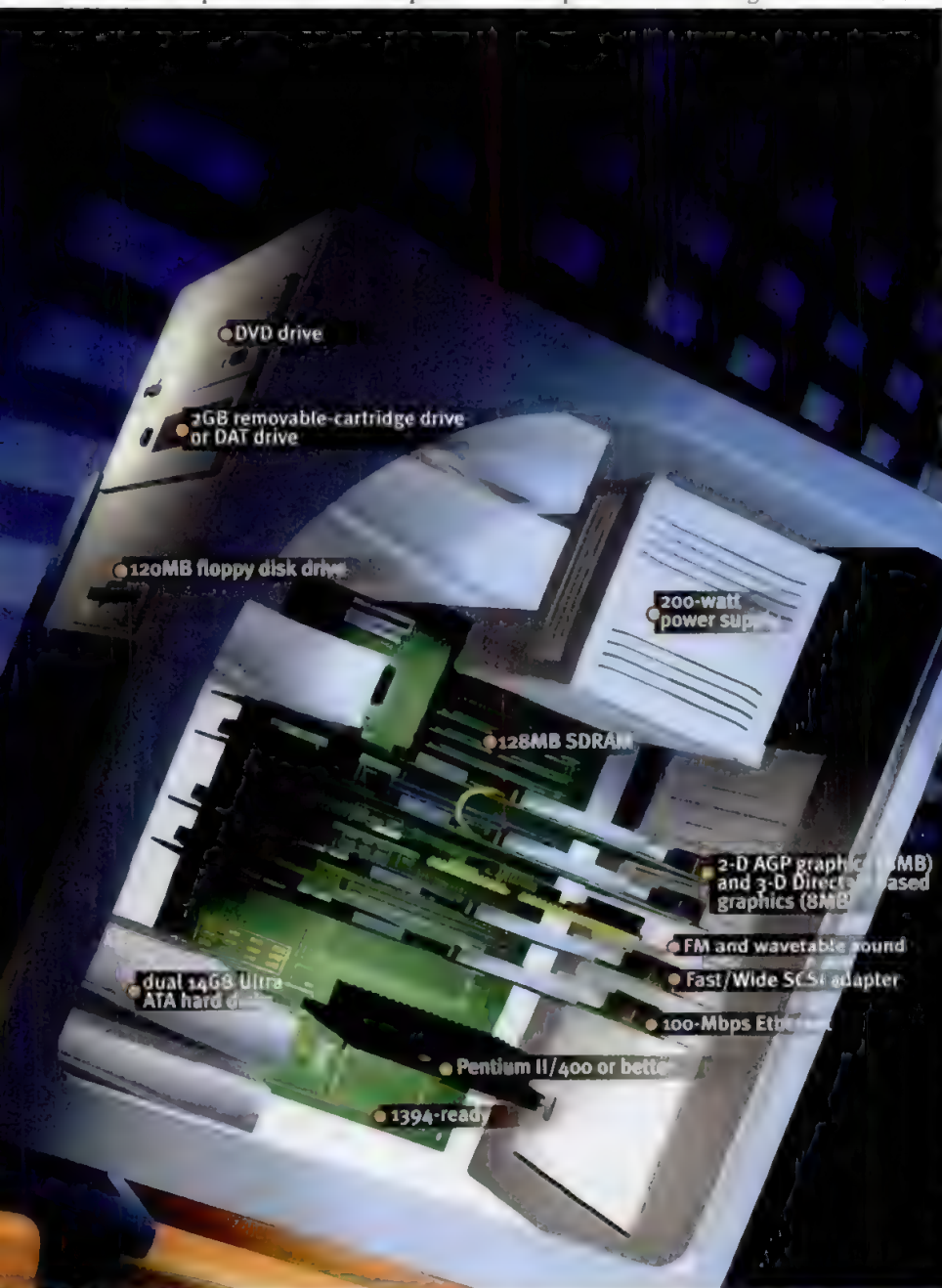
MULTIMEDIA AND CONNECTIONS

A 2X DVD drive is a must. Although no standard has been set for recordable DVDs, you should still get a DVD drive and enjoy the larger storage capacity of DVD disks (from 4.7GB to 17GB). To get top-level picture and sound, make sure that your system has hardware-based decoding of both MPEG-2 (for video) and Dolby Digital 5.1 (formerly AC-3). The latter provides you with five discrete sound channels plus a subwoofer. Couple that with a sound card with wavetable and FM support, and at least a three-piece speaker system. If you want the full benefit of all five channels, however, don't settle for just left and right speakers: You'll need to be exactly midway between the two speakers to hear the emulation, and even there the output may not sound truly realistic.

The dream PC includes both a 100-Mbps Ethernet card and an Fast/Wide SCSI card. You'll need the former not only for standard networking but also for a cable modem hookup. ISDN may be more widely available; still, you'll get more speed out of a cable modem—provided your area offers the cable-modem option. Cable modems have a maximum throughput of 10 Mbps (more typically 1.5 Mbps to 3 Mbps) versus ISDN's 128 Kbps.

Most peripherals you're likely to want are now (or soon will be) USB-based, but there are still storage solutions such as CD-R drives that work best with SCSI. The dream PC should have at least two USB ports: A USB videoconferencing camera is a good optional purchase, and other attractive peripherals such as digital still cameras and scanners are now available. Make sure your PC is ready for IEEE 1394 (or FireWire). This superfast (400-Mbps) serial connection has few devices that take advantage of this now, but many should be coming to market over the next year.

Finally, you should protect your PC with a 650-VA uninterruptible power supply.



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Office PC

Desktop management has come of age: You can have the control you need, choose your level of power, and select the form—either a standard PC or a Net PC—that best suits your needs. By Cade Metz

Today's corporate PC focuses on manageability, not raw speed. Though additional performance is always welcomed by end users, IT administrators charged with maintaining large business installations desire machines that are easily set up, upgraded, and repaired. To satisfy such administrators and the companies that employ them, most major vendors now sell their corporate machines with preinstalled network cards, tractable chassis designs, and integrated desktop management solutions.

These systems are essentially divided into two categories: classic desktops (standard PCs modified to facilitate management) and Windows-based Net PCs (scaled-down, sealed systems that typically pull applications and most of their data from a server but handle processing locally). In addition to extensive management features, the perfect corporate desktop offers fast core—hardware—including a 350-MHz or faster Pentium II processor, Intel's 440BX chip set, an AGP card, 64MB of SDRAM memory (for Windows NT PCs—Windows 95 or 98 PCs can use 32MB), and a 10GB Ultra ATA hard disk. Meant to conserve space and further reduce costs, the perfect Net PC is more modest: It lacks external drives, forgoes AGP, and uses a 233-MHz Pentium MMX proces-



sor, although systems with faster CPUs are available.

THE PERFECT CORPORATE DESKTOP

The cornerstone of the perfect corporate desktop is a tractable chassis—one quickly opened and serviced. Its external casing is fastened shut with thumbscrews or snap-out clasps, permitting entry without a screwdriver. Once inside, you should also have easy access to all primary hardware components.

With Dell's OptiPlex GX1, for instance, a plastic chassis cover pops off when you

gently release a rear latch. Inside the chassis, a hinged power supply swings up to reveal the system's processor and memory slots on the upper half of the motherboard, and a horizontal bus-slot card slides out to expose the lower half. With other machines, such as Digital's PC 5510, the motherboard readily slides out of the chassis on rails. Whatever method is used, quick and easy access to internal hardware reduces the time and difficulty involved with upgrades and repairs, thus lowering costs.

Much of this benefit is lost, however, if your machine lacks room for expansion.

At the very least, it needs an AGP slot, two or three available PCI slots, and a pair of unused memory slots. Unless you're reusing legacy hardware—which we certainly wouldn't do with our perfect system—open ISA slots are no longer needed. Almost all of today's high-end cards (with the exception of modems) use the PCI bus.

Although top graphics aren't the focal point of a corporate system, and most integrated solutions are adequate for standard business applications, your corporate PC still needs a standard AGP slot. Without such a slot, you must buy an entirely new PC when it comes time to upgrade graphics. Ideally, a vendor will also offer three or more DIMM slots and install its 64MB of SDRAM with a single module.

TCO is further reduced with a bundled desktop management solution—a series of software agents and hardware enhancements that let administrators monitor and maintain machines from a remote console. These solutions—including Compaq's Insight Manager, Dell's OpenManage, HP's TopTools, and Intel's LANDesk Client Manager—are compliant with the latest DMI (Desktop Management Interface) specification, but they may also provide such remote-management functions as health monitoring, chassis-intrusion detection, system wakeup, remote BIOS updating, and remote component locking.

As defined by the Version 2.0 spec, DMI lets you inventory a machine's major components via software. This can prevent hardware theft and ease the repair process, but like chassis-intrusion alarms and motherboard temperature monitors, it isn't as useful as the ability to wake up a machine (via remote LAN wake-up technology) or flash its BIOS remotely (via various proprietary methods). To load an OS or distribute software applications from a remote console, you'll need another application: Intel's LANDesk Configuration Manager or ON Technology's ON Command Comprehensive Client Manager if you're performing the initial installation; or a package such as Microsoft SMS for incremental upgrades.

Of course, you can't use a remote desktop management package if your machine isn't connected to a LAN. Our perfect cor-

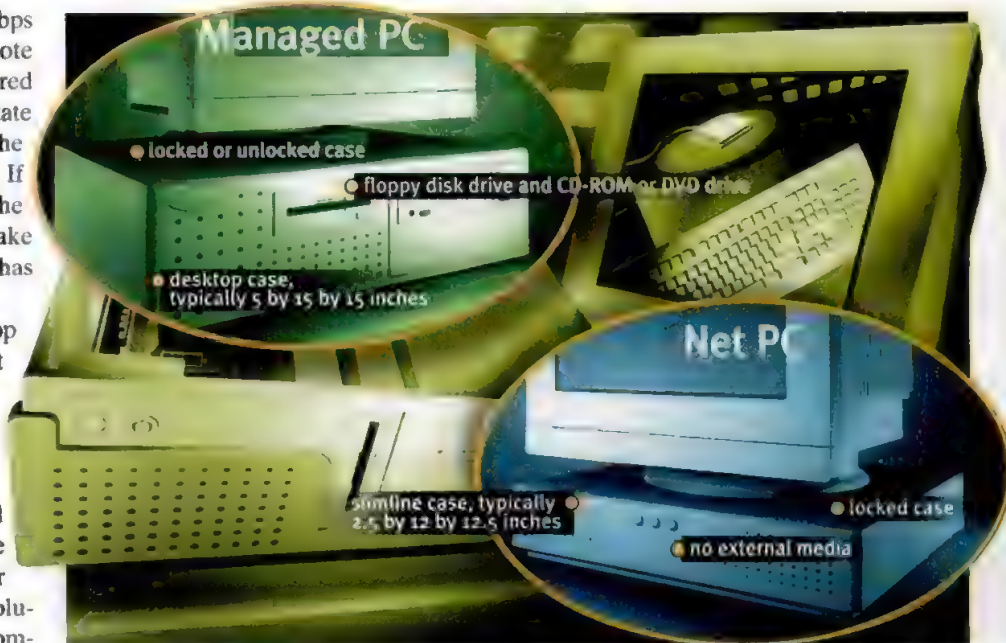


porate desktop ships with a 10/100-Mbps Ethernet adapter that supports remote LAN wakeup. When a machine is powered on, such an adapter sits in a low-power state and waits for a magic packet from the remote desktop management console. If the packet arrives, it then wakes the machine up, letting administrators make remote queries even after a machine has been turned off for the evening.

Lastly, our perfect corporate desktop forgoes Plug and Play for the moment and opts for the added stability and security of Windows NT; most professional/enthusiast or home machines will offer the simplicity of Windows 98. A later upgrade to Windows NT 5.0 will include Plug and Play capability. Couple your managed desktop with a larger third-party enterprise management solution, such as IBM Tivoli TME, for a complete enterprise management solution.

THE PERFECT NET PC

Appropriate for environments where extra security is necessary or where repetitive tasks are performed, the perfect Net PC is not as extravagant as the managed desktop. To prevent employees from introducing compatibility problems, running unauthorized applications, or tampering with internal hardware, it lacks a floppy disk drive and CD-ROM drive and uses a



sealed chassis. Since the server plays such an important role in everyday operation, it does not require the high-end core components, storage space, or expansion room of the perfect corporate desktop. Consequently, both space and cost are minimized. The perfect Net PC is 25 percent smaller than its desktop counterpart, and many a Net PC sells for just over \$1,000 with the monitor included.

Like corporate PCs, however, Net PCs ship with extensive management features.

They integrate remote LAN wake-up adapters and offer remote functions such as DMI querying, health monitoring, and BIOS updating. Our perfect Net PC also provides a preboot execution (PXE) agent, BIOS code that—when paired with a third-party product such as Intel's LANdesk Configuration Manager—lets you boot the system before its OS has been loaded or in the event of a hard disk crash. A Net PC typically houses its own OS, but using a PXE, it can boot from a remote console.

Glossary of Management Initiatives

ACPI Advanced Configuration and Power Interface; a specification defining a new interface to system boards that lets the OS direct power management and system configuration.

DMI Desktop Management Interface; a specification created by the Desktop Management Task Force (DMTF) to standardize the exchange of information among clients and administrators. DMI 2.0, the most recent version, has added standardized

remote procedure calls (RPCs).

PC98 A PC design guide for 1998, coauthored by Intel and Microsoft with aid from other industry vendors and covering the PC system, bus, and devices. PC98 includes (for the first time) guidelines for various types of mobile PCs, new requirements for manageability and remote boot-up support, and new specs for IEEE 1394, among others. The basic PC98 PC should have no ISA devices; PC99 is expect-

ed to do away with ISA slots altogether.

WBEM Web-Based Enterprise Management Initiative; a standard being developed by BMC Software, Cisco Systems, Compaq, Intel, and Microsoft to allow applications to describe, access, and report management data from a variety of sources (DMI, OS, SNMP, and others) regardless of the original source of that data. It aims to be platform-independent.

WfM Wired for Management; an Intel-led initiative to define guidelines for making Intel-compatible systems more manageable. It supplements DMI and covers asset management, remote configuration and reconfiguration, and remote wake-up and power management features.

ZAK Zero Administration Kit for Windows NT workstations; a set of tools and methodologies from Microsoft for IT managers and system

vendors to simplify the implementation of secure policy management, where administrators can restrict users from accessing such things as files and applications in Windows NT.

ZAW Zero Administration initiative for Windows; a Microsoft-spearheaded initiative focused on making Windows and Windows NT systems more manageable through greater centralized control and automation of administrative tasks.



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Home PC

You can get more than ever for your money: Competition and the growth of the sub-\$1,000 PC market have driven prices down across the board.

By Cade Metz

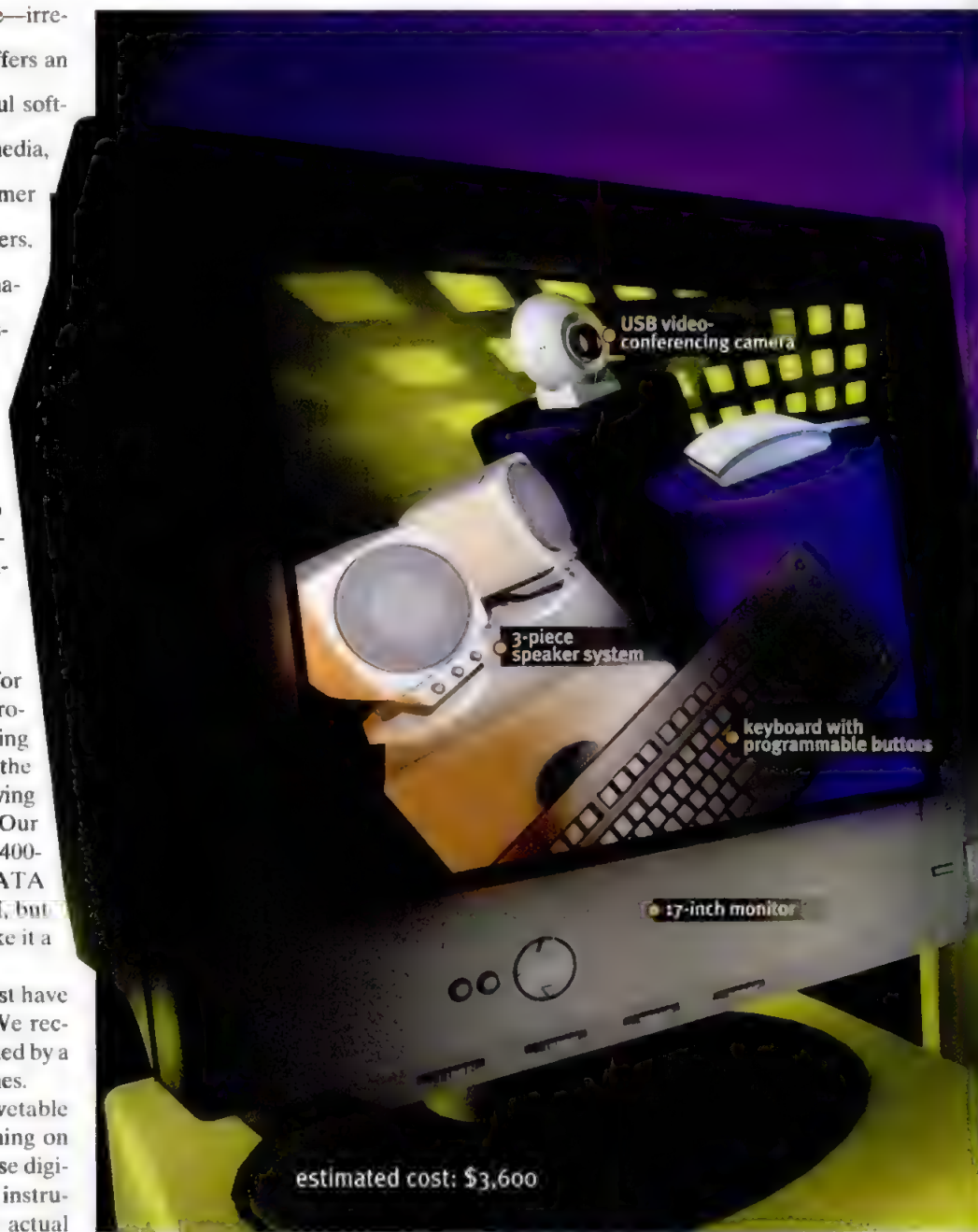
An ideal home machine—irrespective of price—offers an attractive exterior casing, plentiful software applications, high-end multimedia, and integrated support for consumer electronics devices such as TV tuners, speakerphones, and answering machines. The perfect sub-\$1,000 system lacks such extravagant components but offers power—including a 266-MHz or faster processor, at least 256K of L2 cache, a 2GB to 3GB hard disk, a 24X or 32X CD-ROM drive, and productivity applications.

THE PERFECT HOME PC

Though the home PC is still used for standard operations, it must also provide the right hardware for playing games, listening to music, surfing the Internet, making phone calls, viewing movies, and even watching TV. Our perfect Windows 98 system has a 400-MHz Pentium II, a 10GB Ultra ATA hard disk, and 64MB of SDRAM, but processing components don't make it a home PC.

If only for 3-D games, you must have an adept 128-bit graphics card. We recommend an AGP card, accompanied by a monitor measuring at least 17 inches.

Next, our machine needs a wavetable audio card—preferably one running on the PCI bus. Whereas FM cards use digital approximations of musical instruments, a wavetable board uses actual



THE COMPUTER Book PAGE.

PETER NORTON'S COMPLETE GUIDE TO WINDOWS® 98

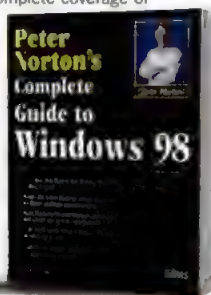
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EASY WINDOWS® 98

by Shelley O'Hara

Cut to the chase with this handy tutorial that simplifies the tough tasks and makes the simple tasks second nature. Each page is packed with tips and techniques to speed you through Windows 98. (Que)

Publisher's Price: \$19.99

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QUICK COURSE® IN MICROSOFT® WINDOWS® 98

by Online Press, Inc.

A-type personalities, this is the Windows 98 book for you! Concise advice and cost-effective, this Quick Course will help you customize, find shortcuts, and get right to using Microsoft's latest OS. (Microsoft Press)

Publisher's Price: \$14.99

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WINDOWS® 98 COMPLETE REFERENCE

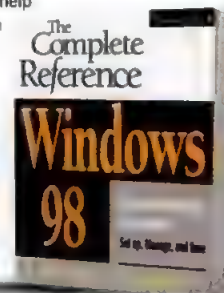
by John Levine
and Margaret Levine Young

A complete course, *Windows 98 Complete Reference* contains all you need to master Microsoft's latest revolution. Superior indexing and clear visuals help thoroughly explain every element of the new OS. (McGraw-Hill/Osbourne)

Publisher's Price: \$39.99

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WINDOWS® 98 SECRETS

by Brian Livingston
and Davis Straub

Experts take you "behind the scenes" of Windows 98. All the hidden tricks you can perform to corral the power of the latest version of Windows are revealed in a book that provides maps to many shortcuts. (IDG)

Publisher's Price: \$49.99

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B&N Price \$39.99



recordings. Of course, this board is useless without a pair of high-end external speakers and a subwoofer.

For Internet access and telephony functions, our system provides a stand-alone microphone and a 56-Kbps modem. Users in areas where cable modems are available should look for them, however: both the cable modem box and the service are offered via your cable operator. With bundled software, you should be able to set up an

Internet account easily, then configure the PC to answer your phone, take messages, receive and send faxes, and act as a two-way speakerphone. Free Internet time (one to three months) typically is a welcome perk but not a must.

Though it reads standard CD-ROM disks at 16X to 24X instead of the 32X of the top CD-ROM drives, a DVD drive is important for our perfect system as well. With a decoder card like Quadrant International's Cinemaster Card, such a drive

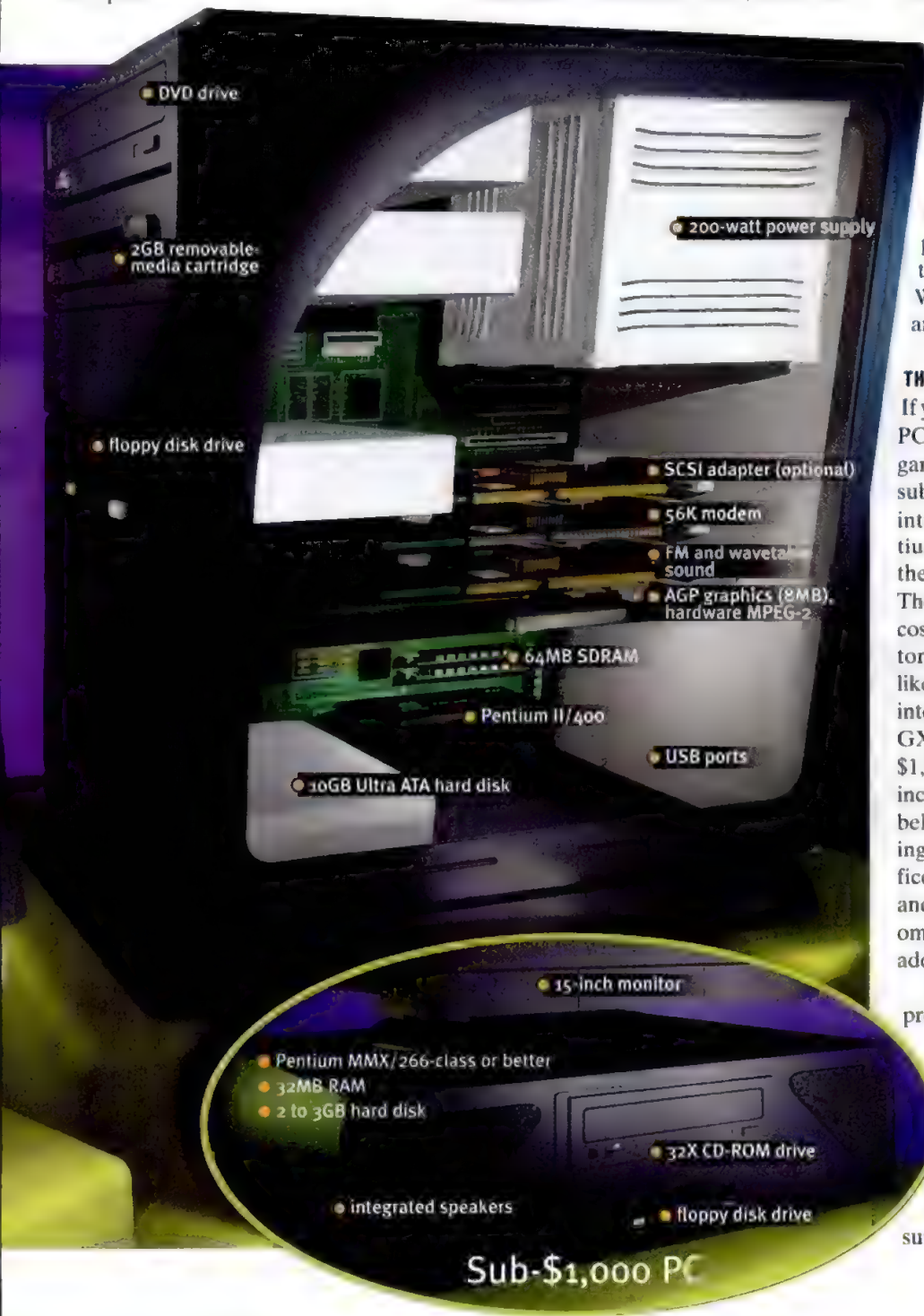
lets you play enhanced DVD games and view movies in high-quality MPEG2 video. With a TV tuner card and a 21- to 30-inch monitor, you can even watch TV on your PC.

These multimedia components are contained in contoured, colorful casing and augmented with scads of gaming, edutainment, and home-office applications. Some vendors also provide external controls for their DVD drives, telephony functions, and Internet schemes and offer keyboards with one-touch, programmable access to applications. Make sure your system has at least two USB ports: USB peripherals such as digital still cameras and videoconferencing cameras (handy for keeping in touch with absent family members) are becoming more available. And with Windows 98, USB support will be built in. Look for systems that are 1394-ready (also known as FireWire). Peripherals for this ultrafast bus aren't here yet but will appear next year.

THE PERFECT SUB-\$1,000 HOME PC

If you're in the market for a second home PC and don't intend to play heavy-duty games or require extensive multimedia, a sub-\$1,000 unit may be for you. Intel has introduced Celeron—a 266-MHz Pentium II without L2 cache meant for what the company calls the basic PC market. The Celeron isn't yet marketed for the PC costing less than \$1,000 including monitor. But by the time you read this, you're likely to find Celeron chips, AMD K6s, or integrated chips, such as the Cyrix MediaGX, in such systems. Our perfect sub-\$1,000 machine is not so perfect as to include a monitor as part of the price: We believe that sub-\$1,000 machines including monitors require you to make sacrifices in processor power, hard disk size, and graphics capability that we don't recommend. A 14- or 15-inch monitor will add \$200 to \$300 to the final price.

Our perfect machine uses a 266-MHz processor—either from AMD, Cyrix, or Intel (a Pentium MMX, and in some cases, a true Pentium II)—and has at least 256K of L2 cache. You should insist on a 24X or faster CD-ROM, a 56-Kbps modem, and some software, but you must settle for inexpensive integrated graphics and audio. Do make sure that your machine offers Direct3D.



MICROSOFT WINDOWS® 98 AT A GLANCE

by Jerry Joyce and Marianne Moon

Finally, an inexpensive fast-track to the right answers. Most every task you'll ever perform in Windows 98 is covered here, and the information is easy to find, concise, and on target. (Microsoft Press)

Publisher's Price:
\$16.99

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\$13.59



Open up the Windows® of possibility.

MICROSOFT® WINDOWS® 98 STEP BY STEP

by Catapult, Inc.

This book is filled with real-world examples, all laid out in easy-to-follow procedures that takes you one step at a time through the lessons you need to utilize Windows 98. (Microsoft Press)

Publisher's Price:
\$29.99

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B&N Price
\$23.99



WINDOWS® 98 BLACK BOOK

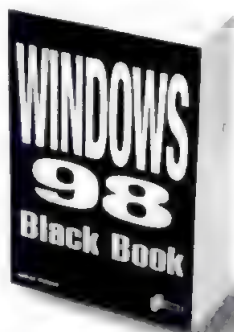
by Nathan Wallace

The hands-on approach of the "Black Book" digs into the particulars of Windows 98, and is perfect for the professional person who just wants to implement, deploy, and enjoy. (Coriolis)

Publisher's Price:
\$39.99

Discount 20%

B&N Price
\$31.99



TEACH YOURSELF WINDOWS® 98 IN 21 DAYS

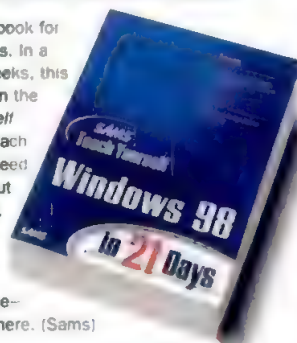
by Michael Hart and Paul Cassel

The perfect book for intermediates. In a few short weeks, this latest book in the Teach Yourself series will teach you all you need to know about Windows 98, from DCOM to Active Desktop to new hardware—it's all right here. (Sams)

Publisher's Price: \$29.99

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B&N Price \$23.99



SPECIAL EDITION USING WINDOWS® 98

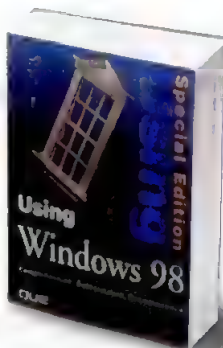
by Ed Bott and Ron Person

A brand-new edition of the industry's top-selling Windows reference/tutorial covers the breadth of Windows 98 know-how. Internet Explorer 4.0, Dynamic HTML—everything under the Windows 98 sun—is included here. (Que)

Publisher's Price: \$39.99

Discount 20%

B&N Price \$31.99



WINDOWS® 98 FOR DUMMIES®

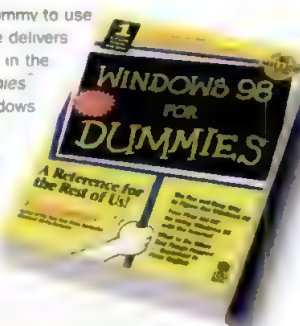
by Andy Rathbone

You don't have to be a dummy to use this guide. Andy Rathbone delivers the skinny on the new OS in the wildly popular ...for Dummies® series, sure to make Windows 98 users of us all. (IDG)

Publisher's Price: \$19.99

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Living-Room PCs

Want to browse the Web or access an electronic encyclopedia from your sofa? New convergence products are making it possible.

By Angela Tuka

Two primary types of convergence PCs exist: WebTV-style Internet appliances and PC/TV systems. Internet appliances (the WebTV and WebTV Plus receivers) integrate into your already existing home entertainment system and hook up to your TV. They're meant for users who only want to access the Web and send e-mail. If you use WebTV with your only phone line, you should have Call Waiting; that way, you'll be returned to where you left off once the call is over. WebTV is too limited: If you're considering an Internet appliance,

choose WebTV Plus, with a 1.1GB hard disk, a printer port, and an internal 56.6-Kbps modem. With the optional wireless keyboard, the Mitsubishi, Philips, and Sony receivers cost about \$250—plus about \$25 per month for unlimited Internet access.

PC/TVs offer excellent DVD video quality, come with wireless keyboards and remote controls, and integrate into your stereo setup. You can either purchase all-included systems such as Gateway's Destination DMC (about \$5,000) or opt for lower-cost systems such as Ino Technologies' TV/PC (\$700 and up)

or TigerDirect's PC Cinema (\$999).

The Gateway comes with a 36-inch monitor, a Dolby Digital receiver, and five Boston Acoustics speakers and a subwoofer. It also has a Pentium II/400 CPU, a 14.4GB hard disk, 128MB of RAM, a 56K modem, and a 4MB 3-D graphics card.

A la carte solutions come with 200-MHz CPUs, 2GB hard disks, and 33.6-Kbps modems. They can connect to either a TV or a PC monitor. Speakers are separate. The Pentium MMX/233-based Philips DVX8000 Multimedia Home Theater comes with everything except the display (but including a Dolby Digital 5.1 stereo amplifier) yet sells for an eye-popping \$5,000.





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*Starting U.S. street price. Monitor not included. International Data Corp. Q4 1997 worldwide factory shipment results for leading PC manufacturers versus year-ago quarter. Intel Inside and Pentium are registered trademarks and PPAI is a trademark of Intel Corporation. Microsoft and Windows NT are registered trademarks of Microsoft Corporation. ©1998 Hewlett-Packard Company. PPG488



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Home Office

To run your business efficiently, start with a high-powered system and pair it with the right peripherals.

By Cade Metz

The computing needs of PC enthusiasts and SOHO users differ markedly from those of a large corporation. Whereas the corporate PC is built for manageability over a LAN, the home-office PC is built for speed and primarily standalone productivity. Whether running your own business or finishing some office work at home, you need a potent Pentium II machine with adequate telephony features, such as a full-duplex speakerphone, and supporting peripherals.

Our perfect home-office PC begins with the 400-MHz Pentium II and Intel's 440BX chip set. With the BX interfacing with main memory at 100 MHz, we found that this combination provided a 12 percent performance improvement over 333-MHz systems with 66-MHz memory buses on some tests. Of course, such a high-end CPU should be surrounded with other high-end components—including 64MB of SDRAM, a 10GB Ultra ATA hard disk, AGP graphics, and a wavetable audio card.

You should get a 1GB SyQuest Sparc drive (\$200) for backup and an ISDN connection or cable modem. The latter can give you brisk Internet access and—with the addition of a camera mounted atop your system—adequate videoconferencing. Machines can be further equipped with fax capabilities, but you'll probably be better off getting an all-in-one external device that combines a printer, copier, and fax machine. Although you'll often get scanning functions with such a device, we still recommend a standalone scanner for higher-quality images.





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As a stand-alone copier it's in a class by itself, making up to 99 copies from a single scan. And as a 600 dpi network printer, it lets you produce sorted, stapled, finished documents right from your desktop. So while the computer may be optional, the Ai3030 is anything but. For more information call 1-800-ABC-MITA or visit www.mita.com.



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How to Choose the Perfect PC

Here are *PC Magazine's* recommendations for the perfect business, home, and dream desktops, as well as for portable PCs.

By Anush Yeghazarian



You'll find our tailored recommendations for various desktop and notebook users in the following pages. As a general rule, we advise you to buy the fastest or second-fastest processor available, to ensure that your investment will last. If you want today's best price/performance leader, look for a processor one or two levels down from the top. Don't pair a Windows 98-based system with less than 32MB of RAM; Windows NT systems should have 64MB or more.

Storage is relatively cheap. You shouldn't settle for anything less than a 10GB hard disk in a new desktop and 4GB to 6GB in a standard notebook (5GB for a subnotebook; larger-capacity drives are not available yet in the necessary 12.5-mm form). Most desktops should come with graphics cards that have 3-D support and at least 4MB of RAM, to allow 1,024-by-768 resolution at 24- or 32-bit color.

If you're purchasing a PC for the office, make sure that it is DMI 2.0-compliant and comes with a good desktop management package, such as Intel LANDesk Client Manager 3.3. Look for features such as remote LAN wake-up (better

known through its Intel and IBM name *Wake on LAN*) and remote-on and -off support through your LAN card, a built-in chassis intrusion detector, and an ASIC that monitors motherboard voltages, fan function, and temperature. Certain vendors also offer additional remote management features, such as remote BIOS updating and locking of components. A few vendors also let you better track your assets, with branding of most components. Managed notebooks, like desktops, should have DMI 2.0 compliance and the same management packages. They may also offer security features such as Smart Card readers to restrict notebook access.

WHERE TO BUY

Most users are well served by traditional purchasing strategies such as buying direct from the vendor, from retail outlets, or from VARs. With the growth in Web commerce, however, you may also find what you want—quickly, conveniently, and in many cases more cheaply—on the Web. Most vendors have Web sites that let you get price quotes on specific configurations, purchase online, or be connected with a reseller in your area that has the configuration you need. You'll also find sites such as Net-Buyer (www.netbuyer.com) or PC-Today (www.pc-today.com) with listings for multiple vendors, so you can compare prices.

Buyers' Worksheet: Notebooks

Feature	High-end notebook	Value notebook	Lightweight
Processor	Mobile Pentium II/266	Mobile Pentium MMX/266 or faster	Mobile Pentium MMX/266 or faster
L2 cache	512K	256K or more	512K
System memory	64MB	32MB	32MB
Hard disk	8GB	4-6GB	5GB
System weight	8 pounds or less	7 pounds or more	4 pounds
Display	14-inch XGA TFT	12.1-inch or larger SVGA TFT, HPA	12.1-inch or larger SVGA TFT
Graphics card memory	4MB AGP	2MB, 64-bit	4MB, 64-bit
Battery	Lithium ion	Lithium ion or nickel hydride	Lithium ion
Floppy disk drive	Integrated or swappable for DVD drive, Zip drive, second hard disk, or second battery	Built-in or swappable for CD-ROM drive	External
CD-ROM or DVD drive	Swappable DVD	Swappable 24X CD-ROM	External
Sound card	FM and wavetable	FM	FM and wavetable
Speakers	Stereo with microphone	One speaker, microphone	Stereo with microphone
Modem	56-Kbps	56-Kbps	56-Kbps
PC Card slots	Two Type II with CardBus and Zoomed Video support	Two Type II	Two Type II
I/O ports	VGA, high-speed serial, parallel, USB, docking station or port replicator, NTSC video-in and -out, external keyboard/mouse	VGA, high-speed serial, parallel, USB, docking station or port replicator, external keyboard/mouse	VGA, high-speed serial, parallel, USB, docking station or port replicator
Infrared port	4-Mbps IR	4-Mbps IR	4-Mbps IR
Security lock slot	Included	Optional	Included
Keyboard	Full size	Full size	Full size
Integrated pointing device	Standard	Standard	Standard
Operating system	Windows 98 or Windows NT 4.0	Windows 98	Windows 98
Software bundle	Included	Optional	Included
Warranty	3 years	1 year	3 years
On-site service	1 year (minimum)	1 year	1 year (minimum)
24-hour, 7-day support	Included	Included	Included
Extras	USB videoconferencing camera, portable color printer	Docking station or port replicator	Docking station or port replicator
Price	\$5,000	\$2,000	\$3,500
Your candidates	Notebook A	Notebook B	Notebook C
Company name			
Notebook model			
Processor			
L2 cache			
System memory			
Hard disk			
System weight			
Display			
Graphics card memory			
Battery			
Floppy disk drive			
CD-ROM or DVD drive			
Sound card			
Speakers			
Modem			
PC Card slots			
I/O ports			
Infrared port			
Security lock slot			
Keyboard			
Integrated pointing device			
Operating system			
Software bundle			
Warranty			
On-site service			
24-hour, 7-day support			
Extras			
Price			

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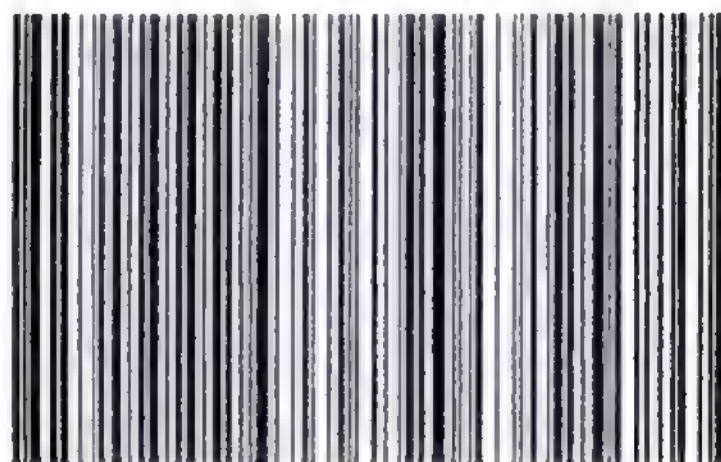
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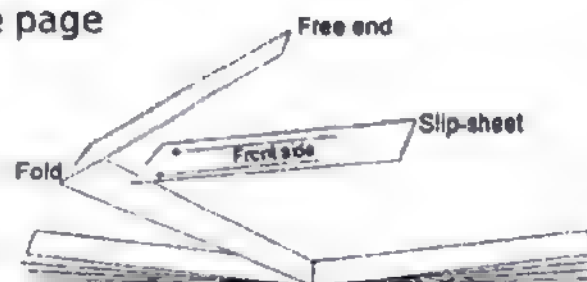
Inverted Foldout slip-sheet

Foldout slip-sheet



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2. Insert this sheet with
 1. Front side touching the free page
 2. Arrow pointing to the fold
3. Slice the folded edge
4. Close the page and slip-sheet

1. Open the foldout page
2. Insert this sheet with
 1. Front side touching the free page
 2. Arrow pointing to the fold
3. Slice the folded edge
4. Close the page and slip-sheet



Buyers' Worksheet: Desktop PCs

Feature	The home PC	The office PC	The dream machine
Processor	Pentium II/350-400	Pentium II/300-class or better	Single or dual Pentium II/400
L2 cache	512K	512K	512K per CPU
System memory	64MB	32MB for Windows 98, 64MB for Windows NT	128MB
Expansion bus	PCI/ISA with USB (2 connectors)	PCI/ISA with USB (2 connectors)	PCI/ISA with USB (2 connectors)
Hard disk	10GB Ultra ATA	10GB SMART Ultra ATA	Two 14GB-17GB Ultra ATA
CD-ROM or DVD drive	DVD	32X CD-ROM	DVD
Sound card	FM and wavetable	Integrated 16-bit	FM and wavetable
Speakers	3-piece, powered	2-piece or integrated on monitor	3-piece, powered
Graphics card memory	8MB AGP with 3-D and hardware MPEG2	4MB AGP	8MB-16MB AGP with Direct3D, hardware MPEG2
Monitor	17-inch	15-inch	20-inch LCD
Modem	56-Kbps or cable (if available)	Optional	Cable, ISDN
Network interface card	Optional (for cable modems or for home networking/printer sharing)	Integrated auto-sensing 10/100-Mbps Ethernet	100-Mbps Ethernet
Floppy disk drive	1.44MB minimum, 120MB optional	1.44MB	120MB
Additional storage/tape backup	2GB removable cartridge drive	Optional	2GB removable cartridge drive or 4-mm 4GB DAT drive
Power supply	200W	150W	200W
Uninterruptible power supply	Standard, 250 VA	Optional	Standard, 650 VA
High-speed ports	Standard parallel, serial	Standard parallel, serial	Standard parallel, serial, 1394
Infrared ports	Optional	Optional	4-Mbps IR
Keyboard and mouse	Standard	Standard	Standard
Operating system	Windows 98	Windows 98 or Windows NT Workstation 4.0	Windows NT Workstation 4.0
Software bundle	Included	Optional	Included
Warranty	3 years	3 years	3 years
On-site service	3 years	1 year	3 years
24-hour, 7-day support	Included	Included	Included
Case locks	None	Standard	Standard
Extras	SCSI adapter, camera for videoconferencing	Optional	Dual-channel Ultra-Wide SCSI adapter, camera for videoconferencing
Price	\$3,600	\$2,300	\$12,000

Your candidates	Computer A	Computer B	Computer C
Company name			
PC model			
Processor			
L2 cache			
System memory			
Expansion bus			
Hard disk			
CD-ROM or DVD drive			
Sound card			
Speakers			
Graphics card memory			
Monitor			
Modem			
Network interface card			
Floppy disk drive			
Additional storage/tape backup			
Power supply			
Uninterruptible power supply			
High-speed ports			
Infrared ports			
Keyboard and mouse			
Operating system			
Software bundle			
Warranty			
On-site service			
24-hour, 7-day support			
Case locks			
Extras			
Price			

How to Contact the Leading Vendors

Below we supply contact information for several companies, many of which were rated in this year's Service and Reliability Survey. In some cases, a vendor's warranty differs from line to line, so we indicate a range. Often, coverage can be extended for an additional charge—though it may be through a third party.

Vendor	Toll-free number	Local number	Web site	Tech. support (eastern)	Warranty (years)		On-site service (1 year)		Money-back policy *
					Desktops	Notebooks	Desktops	Notebooks	
Acer (CA)	800-733-2237	408-432-6200	www.acer.com/aac/	24 hours, 7 days	3	1	Included	None	None
Apple (CA)	800-776-2333	408-996-1010	www.apple.com	9:00-9:00 M-F	1	1	Included	None	No direct sales
AST** (CA)	800-876-4278	714-727-4141	www.ast.com	24 hours, 7 days	1-3	1-3	Included	Included	No direct sales
Compaq (TX)	800-345-1518	281-514-0484	www.compaq.com	24 hours, 7 days	1-3	Parts, 1-3; labor, 1	Included	None	30 days
Dell (TX)	800-289-3355	512-338-4400	www.dell.com	24 hours, 7 days	3	Parts, 1-3; labor, 1	Included	Included or up to \$149	30 days
Digital (MA)	800-344-4825	978-467-5111	www.windows.digital.com	24 hours, 7 days	Parts, 3; labor, 1	3	Included	Included or \$149	30 days
DTK (CA)	800-289-2385	626-810-0098	www.dtkcomputer.com	8:30-5:30 M-F	2	1	\$50	None	No direct sales
Everex (CA)	800-383-7391	510-498-1111	www.everex.com	24 hours, 7 days	1-3	2	Included	None	No direct sales
Fujitsu (CA)	800-838-5487	408-935-8800	www.fujitsu-pc.com	24 hours, 7 days	N/A	1-3	N/A	None	No direct sales
Gateway (SD)	800-846-2000	605-232-2000	www.gateway.com	24 hours, 7 days	3	1	Included	None	30 days
Hewlett-Packard (CA)	800-752-0900	650-857-1501	www.hp.com	8:00-8:00, M-F	3	3	Included	None	30 days
Hitachi (CA)	800-555-6820	408-546-8000	www.hitachipc.com	24 hours, 7 days	N/A	1-3	N/A	None	No direct sales
IBM (NY)	800-426-3333	914-765-1900	www.ibm.com	24 hours, 7 days	Parts, 3; labor, 1	1-3	Included	None	None
Micron (ID)	800-438-3348	208-368-4400	www.micronpc.com	24 hours, 7 days	Parts, 3-5; labor, 1	Parts, 1-5; labor, 1	Included	None	30 days
MidWest Micro (OH)	800-445-2015	937-368-2309	www.mwmicro.com	9:00-9:00 M-F, 10:00-4:00 Sat.	CPU and RAM, 5; parts and labor, 3	N/A	Included	N/A	30 days
NEC (CA)	888-863-2669	978-264-8000	www.neccomputer.com	24 hours, 7 days	3	3	Included	Included	30 days
Packard Bell NEC (CA)	800-733-5858	Info not available	www.packardbell.com	24 hours, 7 days	1	N/A	Included	N/A	No direct sales
Panasonic (NJ)	800-662-3537	201-271-3182	www.panasonic.com/toughbook	24 hours, 7 days	N/A	3	N/A	Included	None
Quantex (NJ)	800-346-6572	732-563-4166	www.quantex.com	24 hours, 7 days	Parts, 3; labor, 1	CPU and RAM, 3; parts and labor, 1	Included	Included	30 days
Sharp (NJ)	800-237-4277	201-529-8200	www.sharp-usa.com	24 hours, 7 days	N/A	3	N/A	None	No direct sales
Sony (CA)	800-352-7669	408-432-1600	www.ita.sel.sony.com	24 hours, 7 days	1	N/A	Included	N/A	No direct sales
Toshiba (CA)	800-334-3445	714-583-3000	computers.toshiba.com	24 hours, 7 days	1-3	1-3	Included (90 days or 1 year)	\$49	No direct sales
Unisys (CA)	800-874-8647	408-434-2848	www.pc.unisys.com	24 hours, 7 days	3	3	Included (in some areas)	None	90 days
WinBook (OH)	800-339-9694	614-481-7460	www.winbook.com	8:00 A.M.-9:00 P.M. M-F, 9:00-4:00 Sat.	N/A	1	N/A	None	30 days

* Direct sales only.

** Samsung is the parent company of AST.

N/A—Not applicable: The vendor does not sell this type of product line.

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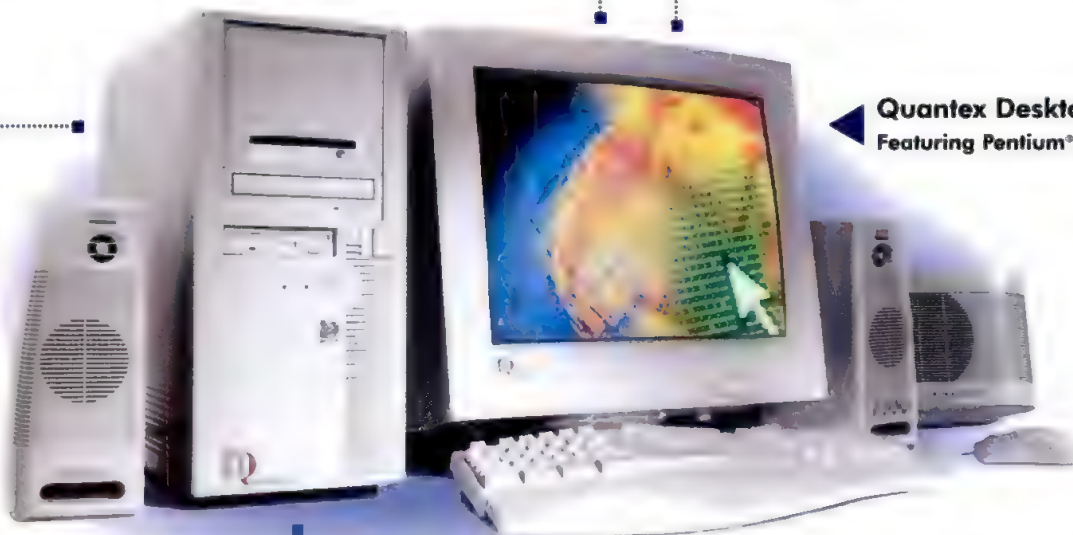
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Upgrades

Your old PC just can't cut it anymore. Is an upgrade the answer, or should you just invest in a new system?

By Anush Yegyzarian

With new technologies heralded from every corner, it's easy to get caught up in hype without taking the time to consider your own needs. If your current system runs all the software needed at an acceptable pace, skip the shopping spree. If, however, you've found that the latest office productivity package, graphics software, or game you want to use just can't run well on your present PC, it's time for a change. Depending on what you need, an upgrade may be the best answer.

For starters, we don't recommend upgrading a 486-based PC. Ever. Buy a good \$2,000 Pentium II system or, if you have a very limited budget, check out sub-\$1,000 PCs. You'll find sub-\$1,000 units based on AMD K6, Cyrix 6x86MX, Pen-

tium MMX, Celeron, and even Pentium II/233 and faster processors. These new systems will net you performance that is four to six times as fast as with your 486. They are likely to come with 32MB of RAM, 2GB to 3GB hard disks, a fair graphics card with some 3-D support, built-in audio, and a 24X or faster CD-ROM drive.

Motherboard upgrades can be tricky, but if you feel comfortable doing one, you'll get more for your money: Start with a 266-MHz or faster Pentium II motherboard. Then add 32MB of SDRAM, a new 8GB Ultra ATA hard disk, and a new AGP-based graphics card. You will have spent less than \$1,000 for your new system. Of course, you'll have to back up data before replacing your hard disk, which is a major chore in itself, or you may opt simply to keep both disks. Just make sure to use your new disk as the boot disk and your old one as the secondary. Another drawback

of this approach is that you'll get only component warranties instead of the support you can expect with a new system. You'll also forgo Windows 98 and any software packages that vendors throw in.

Your options expand if you have a Pentium-based system. See the chart below for our recommendations. If you're starting from a Pentium system, a processor upgrade is possible. Both AMD and Cyrix have new Socket 7 processors that offer MMX extensions and will soon offer 3-D enhancements as well. Either is more cost-effective than an Intel OverDrive solution and is more likely to increase your performance. Make sure to check either company's Web site for a list of compatible motherboards. As a bare minimum, make sure you have a dual-voltage motherboard. (For more information, see "When Do Upgrades Make Sense?", *PC Magazine*, April 21, 1998.) **PC**

Upgrade Guide

Below are our recommendations for upgrading your PC if you're starting out with a system based on a Pentium (classic) processor, with at least 16MB of RAM.

If you want to spend	To improve performance	To enhance multimedia	To improve 3-D	To increase storage
\$200 or less	Upgrade memory to 64MB EDO DRAM (\$80)	Upgrade memory to 64MB EDO DRAM (\$80)	Upgrade memory to 32MB EDO DRAM (\$40), and add a 3-D PCI Graphics card with 4MB RAM (\$150)	Add an Iomega ZipPlus drive (\$190) or a 1GB SyQuest Sparq (\$200)
\$500 or less	Upgrade motherboard to Pentium II/266 (\$440), add 32MB SDRAM (\$60)	Upgrade memory to 32MB (\$30), add a DVD upgrade kit (\$270) and a PCI wavetable sound card (\$160)	Upgrade processor,* add a 3-D PCI graphics card with 4MB RAM (\$150), upgrade memory to 32MB (\$30)	Add an 8.4GB Ultra ATA hard disk (\$300) and an Iomega ZipPlus drive (\$190) or a 1GB SyQuest Sparq (\$200)
\$1,000 or less	Upgrade motherboard to Pentium II/266 (\$440), add 32MB SDRAM (\$60), an 8.4GB Ultra ATA hard disk (\$300), and a 3-D AGP graphics card with 4MB RAM (\$160)	Upgrade motherboard to Pentium II/266 (\$440), add 32MB SDRAM (\$60), a DVD upgrade kit (\$270), and a PCI wavetable sound card (\$160)	Upgrade motherboard to Pentium II/333 (\$680), upgrade memory to 32MB SDRAM (\$60), add a 3-D AGP graphics card with 8MB RAM (\$230)	Add an 8.4GB Ultra ATA hard disk (\$300) and an Iomega ZipPlus drive (\$190) or a 1GB SyQuest Sparq (\$200) or a 2GB Iomega Jaz drive (\$550)
\$1,500 or less	Buy a new Pentium II system	Buy a new Pentium II system	Buy a new Pentium II system	Buy a new Pentium II system

* Only Intel's Pentium OverDrive processor with MMX is readily available, but forthcoming are AMD's K6-2 and new versions of Cyrix's MII—both having MMX and 3-D enhancements. These products may offer better performance and value.

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Processors

From a 100-MHz system bus to a 400-MHz core, it's been a record-breaking year, and things are only going to get faster.

By Anush Yegyzarian

Over the past year, we've seen numerous advances: Intel Pentium II chips have reached 400 MHz, and the system bus is now 100 MHz. And 450-MHz CPUs are just around the corner, with 500-MHz models to follow shortly thereafter. Those chips will appeal mostly to users involved in heavily computational or graphics-intensive work, at least in the short term. As voice and video become more integrated into everyday applications, mainstream users too may need the extra power. Today, a 350- or 400-MHz Pentium II should suit most needs.

Intel wants to bring Pentium II technology to all market segments. To that end, the company has already embarked on the last production cycle of Pentium MMX chips (except for mobile versions), and it has introduced two new CPUs, each with a

Pentium II core: the Xeon for the high end (servers and workstations) and the Celeron for the "basic" PC market.

Neither AMD nor Cyrix has stood still, and they continue to offer solid, lower-cost alternatives to Intel CPUs. Cyrix recently released the 233-MHz M II chip, which it claims is equivalent to a Pentium II/300 (hence the name M II-300). AMD likewise has released a 300-MHz version of the K6.

Both companies have major innovations in the wings, beginning with 3-D enhancements to versions of the K6 and M II. The two companies will use a common 3-D instruction set, and both new processors will still use Socket 7 (Pentium- and Pentium MMX-class). Some Cyrix processors already enjoy 75-MHz buses (the rest of the 586 and 686 PC world is running on a 66-MHz system bus), and both AMD and Cyrix are working on a 100-MHz system bus for Socket 7 processors. Here, the system-bus speed will have more of an effect than in Slot 1 (Pentium II) systems, because it will affect both main memory and the L2 cache. With Slot 1, the L2 cache

is integrated into the processor cartridge (the cache runs at half the CPU speed) and so is unaffected by an increased bus speed. The end result of a faster bus with Socket 7 is a faster, lower-cost PC for you.

INTEL EVERYWHERE: LOW-END

As part of its plan to spread Pentium II technology to all market segments, Intel has released the Celeron, a CPU that has the Pentium II core but currently lacks L2 cache; it's meant for the basic PC market. Although Intel may not say so, that means sub-\$1,000 PCs. But this first incarnation of the Celeron is proving less powerful than competing chips and too expensive for the sub-\$1,000 market. You'll get better value from an AMD- or Cyrix-based PC at the lower end of this market (\$700 to \$800 systems). The market agrees: Processors from AMD have more than 40 percent of the retail market share in this price range.

At slightly higher prices (up to \$999), Intel's Pentium II overmatches the Celeron in performance. In many retail markets, we have begun to see \$999 233- and 266-MHz

Desktop CPUs

AMD,
Cyrix,
or Intel

● Socket 7

● Slot 1 cartridge

● Slot 2 cartridge

Motherboards

Baby AT (1989)

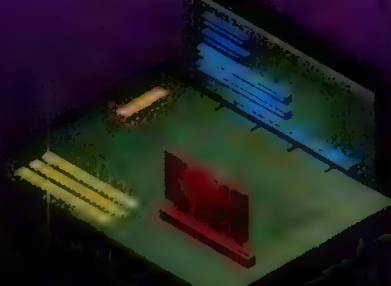
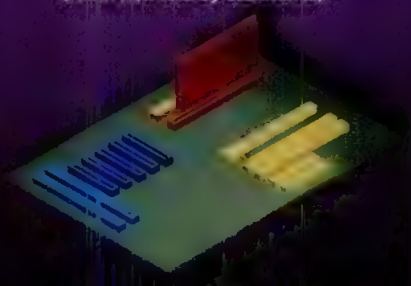
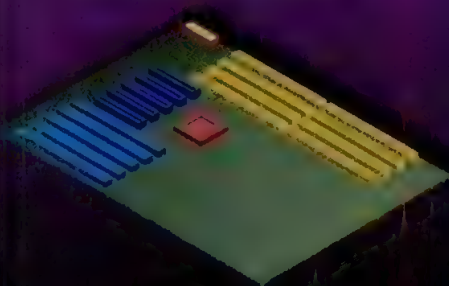
dimensions: 9.0 by 10.0 inches

ATX (1995)

dimensions: 12.0 by 9.6 inches
(mini ATX: 11.2 by 8.2 inches)

NLX (1997)

dimensions: 8.8 by 13.0 inches



ISA slots

PCI slots

CPU slot

Memory

Power supply connector

Pentium II PCs advertised with reasonable configurations (32MB of RAM, 56-Kbps modems, 3GB hard disks), sometimes even with scanner or printer bundles.

The 440EX chip set, an inexpensive version of the current Pentium II 440BX chip set, is helping to lower the cost of Celeron systems and make them more competitive at the low end of the market. The chip set does away with dual-processor support and scales the system-bus speed back to 66 MHz, and EX motherboards offer fewer expansion slots.

A new version of Celeron, code-named Mendocino, is expected by this fall, starting at 333 MHz. This chip will offer 128K of L2 cache—one-fourth that of a true Pentium II—but will run at full processor speed instead of the half-speed of Pentium IIs, so it will have an advantage even against Pentium IIs on some applications. More so than current AMD

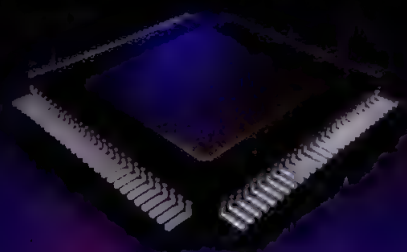
and Cyrix chips, this chip will level the playing field. The Celeron's Pentium II core assures it of better floating-point performance than its competition; also, the addition of L2 cache will put the chip on a par with or above the others for standard business applications, which rely more on integer performance.

The principal area where you'll feel a lack of floating-point performance is 3-D games and applications. If that's important to you, you should probably use the Intel Pentium II, at least until AMD and Cyrix release the 3-D versions of the K6 and M II. The companies planned to have these chips out by summer, but both have delayed the move until later this year. Since the two chips will be compatible with Socket 7, as long as you have a dual-voltage motherboard, you will likely be able to upgrade your Pentium or Pentium MMX system to one of these chips.

INTEL EVERYWHERE: HIGH-END

To take care of the high end of the market, Intel will release the Xeon processors, initially available at 400 MHz, and offered in a new package—a Slot 2 cartridge. This cartridge, like Slot 1 cartridges, will hold the L2 cache, but unlike Slot 1 cartridges, the L2 cache for Xeon processors will run at the full processor speed—harking back to the Pentium Pro. Not surprisingly, the Xeon processor is aimed at the workstation and server markets. The chip will come with three L2 cache levels. The 512K model will go straight into workstations. A 1MB version, released at the same time as the 512K version, will go into servers, at least until the 450-MHz Xeon with 2MB of L2 cache is released in midautumn. ECC SRAM will be standard in all Xeons. Coupled with the 450NX chip set, Xeon systems will offer quad-processor support.

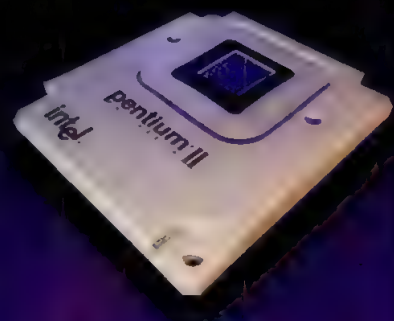
Portable CPUs



Mobile Module



Tape-carrier package (TCP)



Mini-Cartridge

CPU Speeds, Feeds, and Features

Name	Speed (MHz)	System bus speed (MHz)	Integrated L1/L2 cache	L2 cache interface speed	Socket or slot	Core voltage/Average power	Process technology	Special extensions
Pentium (classic)	60, 66, 75, 90, 100, 120, 133, 150, 166, 200	50, 60, 66	16K / None	System bus	Socket 5 or 7	3.3V / 3.0W	0.8µ, 0.6µ, 0.35µ, BiCMOS	None
Pentium (mobile)	75, 90, 100, 120, 133, 150, 166	60, 66	16K / None	System bus	TCP, Socket 5 or 7	2.9V / 6.6W	0.35µ, BiCMOS	None
Pentium Pro	150, 166, 180, 200	60, 66	16K / 256K, 512K, or 1MB	CPU	Socket 8	3.3V / 37.9W	0.6µ, 0.35µ, BiCMOS	None
Pentium MMX	166, 200, 233	66	32K / None	System bus	Socket 7	2.8V / 14.1W	0.35µ, CMOS	MMX
Pentium MMX (mobile)	166, 200	66	32K / None	System bus	TCP, Socket 7	2.5V / 7.7W	0.35µ, CMOS	MMX
Pentium MMX (Tillamook—mobile)	166, 233, 266	66	32K / None	System bus	TCP, Mobile Module	1.8V / 6.7W	0.25µ, CMOS	MMX
Pentium II (Klamath)	233, 266, 300	66	32K / 512K in SEC Cartridge	One-half CPU	Slot 1	2.8V / 38.2W	0.35µ, CMOS	MMX
Pentium II (Deschutes)	333, 350, 400	66, 100	32K / 512K in SEC Cartridge	One-half CPU	Slot 1	2.0V / 26W	0.25µ, CMOS	MMX
Pentium II (mobile)	233, 266	66	32K / 512K	One-half CPU	Mobile Module, Mini-Cartridge	1.7V / 8.5W	0.25µ, CMOS	MMX
Intel Celeron	266, 300	66	32K / None	N/A	Slot 1	2.0V / 16.7W	0.25µ, CMOS	MMX
Intel Xeon	400, 450	100	32K / 512K, 1MB, or 2MB	CPU	Slot 2	Info not available	0.25µ, CMOS	MMX
AMD K6	166, 200, 233, 266, 300	66	64K / None	System bus	Socket 7	3.2V / 28.0W	0.35µ, 0.25µ, CMOS	MMX ¹
Cyrix 6x86	100 (PR 120), 110 (PR 133), 120 (PR 150), 133 (PR 166), 150 (PR 200)	50, 55, 60, 66, 75	16K / None	System bus	Socket 7	2.8V / 14.0W	0.35µ, CMOS	None
Cyrix MediaGX	133, 150, 180, 200	66	16K / None	N/A	Proprietary	2.9V / 4.2W	0.35µ, CMOS	MediaGX ²
Cyrix 6x86MX	133 or 150 (PR 166), 150 or 166 (PR 200), 188 (PR 233), 208 (PR 266)	60, 66, 75, 83	64K / None	System bus	Socket 7	2.9V / 12.4W	0.35µ, 0.25µ, CMOS	MMX
Cyrix M II	233 (PR 300)	66	64K / None	System bus	Socket 7	2.9V / 19.0W	0.25µ, CMOS	MMX

N/A—Not applicable: The product does not have this feature. (1) Licensed. (2) Integrated sound, graphics, and memory controller; with MMX in 200-MHz model.

ON THE HORIZON

Intel processors with integrated 3-D enhancements will reach the market with a chip code-named Katmai, due out by mid-1999. This chip will use a faster Pentium II core, and it is rumored to have a new version of the MMX instruction set, MMX2. We should see 500-MHz and faster speeds in Katmai chips and perhaps even in Pentium II chips. The chip code-named Willamette will mark a real change to the Pentium II core. Due out after Katmai, Willamette supposedly builds on the core of a Pentium Pro (Pentium II's predecessor) and is rumored to be 50 percent faster than current Pentium IIs. And at the end of the century we will see the ramping of IA-64 architecture with the release of the Merced chip; Intel will continue to develop high-performance IA-32 processors.

In the short term, both AMD and Cyrix plan to release chips with integrated L2 cache, much like Pentium IIs. These chips will still be Socket 7-compatible,

however. Over the next year, both companies are looking into releasing Slot 1-style processors. Because AMD no longer has the right to build CPUs that plug into new Intel sockets, it will produce its own slot design, currently called Slot A. Cyrix's licensing agreement allows it to make Slot 1-compatible CPUs, and it is likely to do so.

THE MOBILE WORLD

Earlier this year we saw the introduction of low-power 233- and 266-MHz Pentium MMX chips, code-named Tillamook. They were the first chips to be made in the 0.25-micron process, and they lowered the earlier Pentium MMX core voltage from 2.5 volts to 1.8 volts and dropped average power from 7.7 watts to 6.7 watts. Mobile Pentium II chips are now available in 233 and 266 MHz. These chips raise the power requirements back to 8.5 watts, but their core voltage is about 1.7 volts. The Pentium II chips improve performance by

about 20 percent over the Tillamooks but decrease battery life by 10 to 20 percent; opt for the latter for now if battery life is key for you. Intel will continue to make Tillamook chips into 1999, but faster chips will only appear in the Pentium II line.

AMD has released mobile versions of the K6 chip, now as fast as 266 MHz. These chips have begun appearing in Compaq Presario notebook systems.

MOTHERBOARDS

1997 saw the introduction of a new size for motherboards, popularly known as NLX and frequently found in business-oriented PCs and in desktop models of all kinds. Because these motherboards are smaller, they're well suited for space-constrained desktop cases. They offload their expansion slots onto a riser card that the motherboard plugs into, which allows these boards to be removed quickly and easily, decreasing service time and making them attractive in corporate environments.

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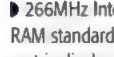


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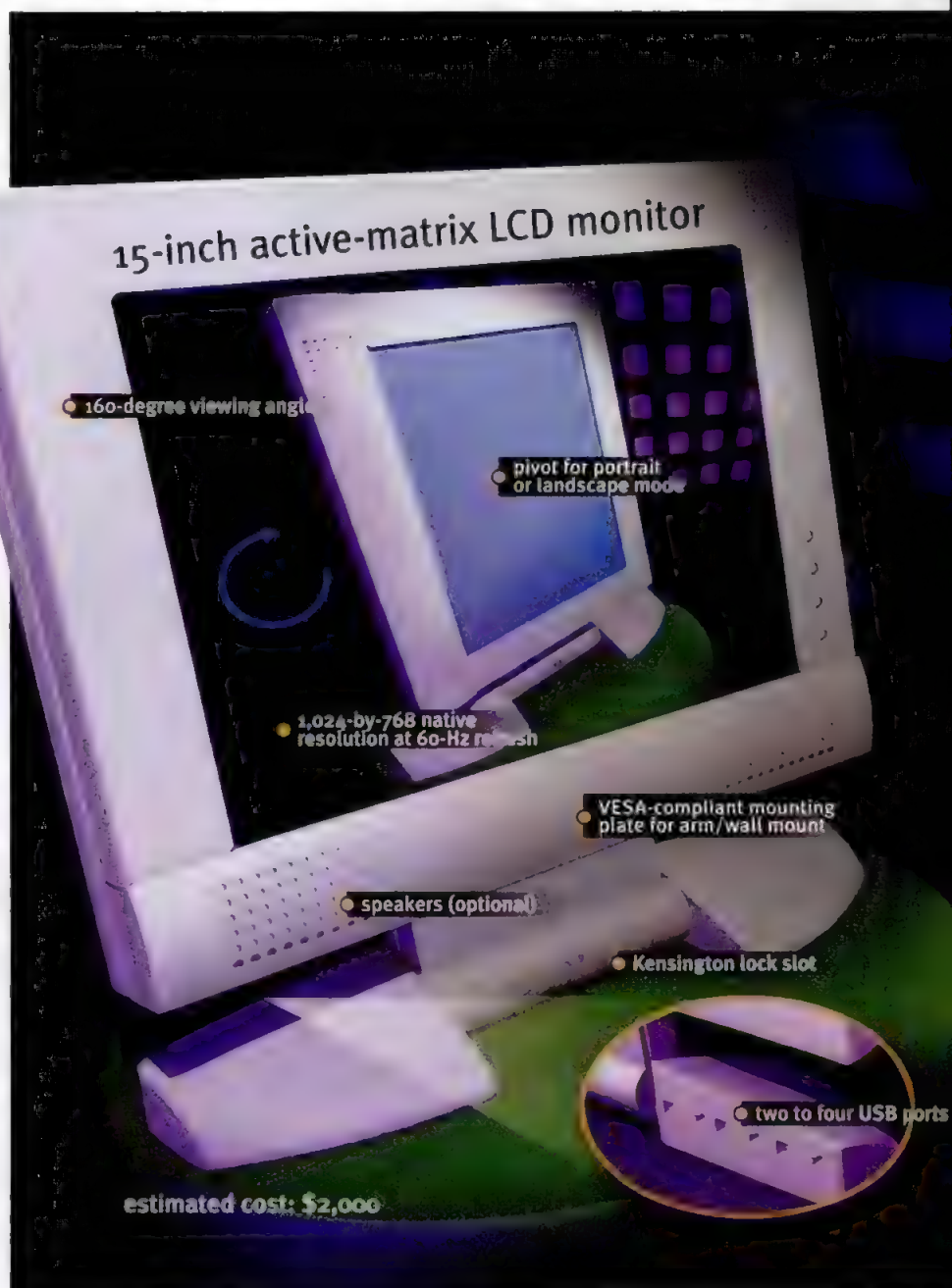
Screen size and monitor type are the important considerations here. CRTs are still the right choice for most users, but LCD is worth investigating.

By Jamie M. Bsales

Too often, users settle for the monitors that come with their PCs, believing that one model is pretty much like another. But the truth is, no PC component varies as much from one to the next as the monitor. As you put together the perfect PC, we recommend you take extra time and specify the monitor that best suits your needs.

For most of us, budget realities limit our choices to a good CRT monitor, as opposed to an LCD flat-panel screen, which is the sexy upgrade right now (more on LCDs in a moment). Although a 15-inch CRT monitor is standard fare for a budget PC and is adequate for a machine that gets occasional use, the perfect PC for the office or home will have either a 17-inch or a 19-inch model. The graphic arts professional will want to go up to a 20- or 21-inch monitor. Note that the size that makers report is the size of the tube's front, measured diagonally, but that the viewable area will be slightly less than that. A viewable area 0.5 to 1 inch less than the tube size is fine; if the viewable area is significantly less than the tube size (say, 1.75 inches or more), look elsewhere.

Why a larger monitor? For productivity and comfort. A 17-inch monitor has about 35 percent more screen area than a 15-inch monitor, and a 19-inch unit delivers 75 percent more; as a result, you can see more of your application at once, with less scrolling around. (Bonus: Games look great!) Also, the larger screens let you work at a higher *resolution*—the size of



the screen image, measured in pixels—so you can keep several application windows open and visible. (See the graphic “Recommended Resolutions” for the resolutions we recommend for each screen size.)

If budget is a factor, opt for one of the high-quality 17-inch models, which you can find for \$500 to \$650 on the street. But if you can afford the extra \$300, we recommend you step up to one of the 19-inch monitors, which just started coming to market last year. Note that although the depth of a larger monitor used to be a limiting factor (especially for cubicle dwellers

and home users), you can now find a short-depth 17- or 19-inch monitor with the same footprint as a 15-inch model.

Once you’ve picked the size, be sure the unit you’re considering delivers an adequate *refresh rate* for the resolution you plan to use. This is the frequency with which the electron guns in the rear of the picture tube redraw the pixels that you see on the screen. The guns send successive waves of electrons to excite the phosphors behind the glass and make them glow as needed. Before a phosphor fades, an electron gun needs to sweep across the screen

again to reignite it. If this refreshing of the screen is too slow, you will notice a flicker. And such flicker, even if barely perceptible, can lead to eyestrain and headaches.

Monitor makers list the refresh rate in *Hz* (hertz) in the specifications for the resolutions that their monitors support, and they list the horizontal scan rate in *kHz* (kilohertz); the higher the number, the better. Look for a refresh rate of at least 85 Hz for the resolution you’re likely to use; the table in the next section, “Specifying Scan Rates and Refresh Rates,” lists the refresh rates and scan rates you’ll want for various resolutions.

Monitors also contain different types of tubes: either *shadow mask*, *aperture grille*, or the newer *slot mask*. The primary differentiation among them is the mask in the tube, which determines the shape of the phosphor pixels. A shadow-mask tube creates the picture element from dots, an aperture grille from vertical stripes, and a slot mask from elongated ovals. Shadow-mask and slot-mask tubes tend to deliver sharper text; they may prove more suitable if your main objective is to run word processing or spreadsheet programs. Aperture-grille tubes generally deliver richer, more saturated colors, so they have the edge for image editing and gaming.

The latest innovation in tube technology is the truly flat tube, with no perceptible curvature of the front glass. Early computer monitors had tubes that curved away from the user at all edges (imagine the front glass as part of a huge sphere), causing glare and distortion of the image. The *flat-square* tubes that are the norm today offer some improvement, since they are curved only at the side edges (as if the glass were part of an upright cylinder).

The newest CRTs do away with the side-to-side curvature as well, cutting down on glare and distortion—a boon for CAD and desktop publishing users in particular, for whom it’s important that straight lines appear straight. After years of working out the manufacturing logistics, last year Panasonic delivered its *PanaFlat* entries, the first truly flat CRTs to support multiple resolutions. (Long-time industry watchers may remember a similar product that Zenith offered years ago, but it was a single-resolution monitor and never caught on.) CRT makers Mitsubishi and Sony have announced their





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THE PERFECT COMPONENTS

MONITORS

own versions, so you can expect to see several manufacturers incorporating the new glass into their designs.

More important than the type of tube, however, is its mask or dot pitch—the distance between phosphors of the same color: As a rule of thumb, the smaller the pitch (quoted in millimeters), the sharper the picture—and the more expensive the monitor. A top-quality shadow-mask or slot-mask tube has a dot pitch of 0.25 mm or less; an aperture-grille unit can deliver an excellent picture with a 0.27-mm stripe pitch or less. Among more affordable monitors, the tube may be 0.27 mm or 0.28 mm for a shadow mask and 0.30 or 0.31 mm for an aperture grille; any higher and picture quality will suffer.

THE LCD ALTERNATIVE

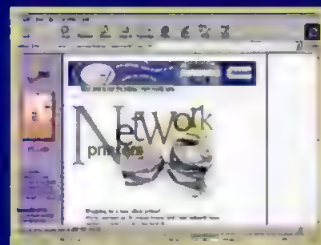
In a perfect world, we would all switch tomorrow from CRT monitors to LCDs. Not only do they take up less desk space and generate less heat and electromagnetic emission than CRTs, they are easier on the eyes, because there is no flicker to speak of.

Before you become enamored, be warned: Prices have plummeted, but LCD monitors are still devilishly expensive. At around \$1,800 to \$2,000, our perfect 15-inch LCD is four times the price of a comparable 17-inch CRT unit. Prices will continue to fall as panel makers increase yields and as production capacity catches up with demand. Industry watchers expect LCDs to cost only 50 percent more than CRTs within two years, and some say LCDs will have replaced CRTs on most desktops about ten years from now.

Today, LCD is right for some niches: stockbrokers' trading desks (where more screens per square foot enable more transactions), medical carts that need to be wheeled from room to room, clean rooms for chip manufacturing (LCDs don't attract dust as CRTs do), and corporate reception areas, where a high-tech look is good PR. The early adopters among you should note that several things distinguish the perfect LCD monitor. For example, look for a panel size of 14.5 to 15 inches. Unlike the CRT, the LCD has a viewable area that is generally the same as its quoted size, so a 15-inch LCD gives roughly the same viewable area as a 17-inch CRT. Any smaller and you'll have to run at a lower resolution than you would on a 17-

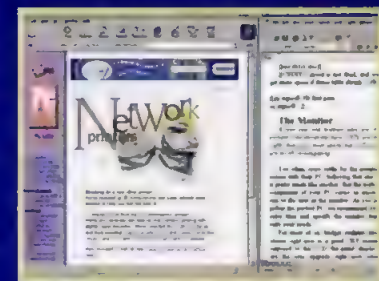
Recommended Resolutions

A larger monitor gives you more screen real estate and lets you run at a higher resolution.



15-inch screen

- 800-by-600 resolution recommended (shown)
- 640-by-480 acceptable
- 1,024-by-768 and higher not recommended



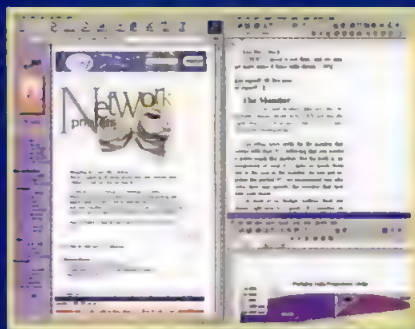
17-inch screen

- 1,024-by-768 resolution recommended (shown)
- 800-by-600 resolution acceptable
- 680-by-480 and 1,280-by-1,024 and higher not recommended

inch unit—not a worthwhile trade-off.

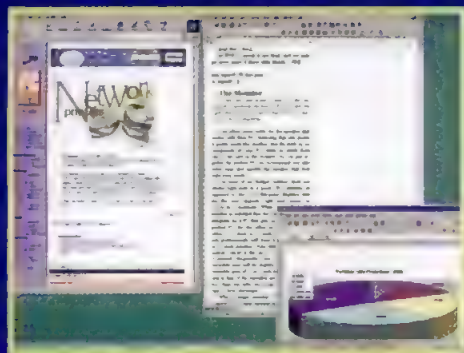
Also, be sure that the panel supports multiple resolutions at full screen; a lesser unit runs at only one resolution or delivers a lower resolution in a smaller window on-screen. And be sure the monitor offers a good scaling technology that can deliver decent image quality at nonnative resolutions. Often, text and lines look blocky and jagged if a monitor doesn't handle interpolation properly.

Not so easy a decision is whether you should go with an all-digital solution or with a monitor that connects to the analog output on a standard graphics card. For some LCD monitors, you need to install a dedicated card in a PCI slot. If



19-inch screen

- 1,024-by-768 or 1,280-by-1,024 resolution recommended (shown)
- 800-by-600 acceptable
- 640-by-480 and 1,600-by-1,200 and higher not recommended



21-inch screen

- 1,280-by-1,024 or 1,600-by-1,200 resolution recommended (shown)
- 1,024-by-768 or 1,800-by-1,440 acceptable
- 800-by-600 and lower not recommended

you have the available slot, you may be rewarded with a better image, since the electronics in the monitor don't have to convert the standard analog VGA signal to the digital signal needed by the panel. The downside is the added cost of the extra card and the inconvenience: If you want to move the monitor to another PC, you have to move the card.

Right now, most of the new LCD models are analog units that connect to the standard VGA-out port of any graphics adapter. (Vendors want to make it as easy as possible for people to upgrade.) This situation may change if the new Digital Flat Panel Initiative (www.dfp-group.org) gains steam. Headed by Compaq and graphics

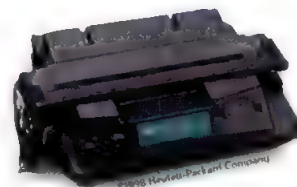
card maker ATI Technologies, the consortium hopes the industry will adopt a digital standard for LCD monitors, in which the digital connector will reside on a standard graphics card along with the analog output for traditional CRT monitors.

ATI expects to release a card with both connectors this fall, at a \$50-or-so price premium over an analog-only card. (The company expects that to drop as volume increases.) The upside is that the monitors themselves might be less expensive, since makers won't need to include the costly analog-to-digital converter. On the monitor side, Compaq, MAG InnoVision, ViewSonic, and others have already expressed support for the new standard.

Other welcome features on the perfect LCD monitor include a wide viewing angle (120 to 160 degrees), so you don't need to be directly in front of the monitor to see the image, as you must with most laptop screens; a pivoting screen, so you can switch from landscape mode (for wide spreadsheets) to portrait mode (for text documents and Web pages); a mounting plate, so you can mount the monitor on a wall or articulating arm; and a Kensington lock socket, since unscrupulous types will soon realize that the lightweight panels easily fit into laptop bags and backpacks.

Finally, whether you're buying an LCD or a CRT monitor, consider the extra features of some units. For instance, multimedia monitors deliver built-in speakers, reducing clutter around your PC. (But we've generally found that the sound quality isn't as good as you would get from a \$50 set of add-on speakers, and game players will want bigger sound.) The latest feature is the inclusion of Universal Serial Bus connectors in the monitor's base, which let you take advantage of the new USB peripherals (keyboards, scanners, mice, cameras, and more) coming to market. You can plug them right into your monitor, so you don't have to reach around the back of your PC to connect and disconnect them. If you're buying a system preloaded with Windows 98 (which offers full support for USB), we recommend a USB monitor.

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Graphics Cards

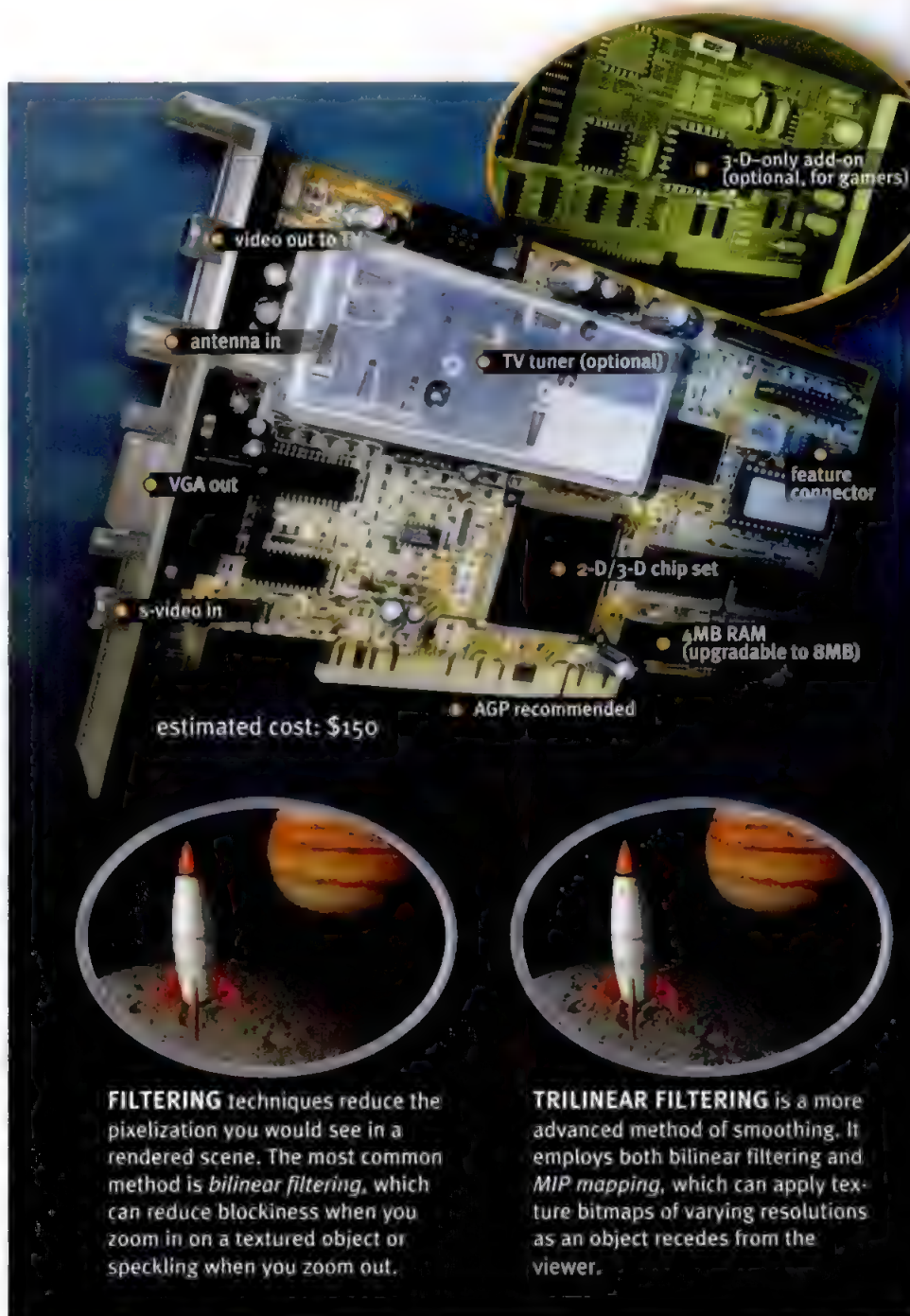
Today's graphics cards do a lot more than speed up scrolling in Microsoft Windows. Look for fast 3-D performance and extra features.

By Josh Levy

To get the most performance out of a perfect PC, you need the best possible graphics accelerator. Whether you play games, surf the Web, or just run standard business applications, there's no substitute for a good-performing adapter that can quickly handle any image you tell it to throw on-screen.

For best results, you'll want an accelerator that employs one of the new 2-D/3-D chip sets that perform well on virtually all graphics tasks. The 2-D element is crucial for tasks such as scrolling, moving windows, and opening dialog boxes, while 3-D acceleration is necessary for the computation-intensive graphics found in today's games—as well as in the coming crop of productivity applications, including spreadsheets and presentation packages. Adequate 2-D/3-D chips now come standard in most PCs, and you can buy an upgrade card for as little as \$80. But a truly perfect graphics card, with all the extra features outlined here, costs about \$150.

The successful combination of 2-D and 3-D has rightly commanded most of the attention in the graphics market. But to understand the benefits this brings, it helps to remember how 2-D works. The essential task of a graphics adapter is to transform commands issued by a program into images on-screen. At the same time, it's expected to *accelerate* that transformation in order to speed how quickly things are drawn (though not how quickly



FILTERING techniques reduce the pixelization you would see in a rendered scene. The most common method is *bilinear filtering*, which can reduce blockiness when you zoom in on a textured object or speckling when you zoom out.

TRILINEAR FILTERING is a more advanced method of smoothing. It employs both bilinear filtering and *MIP mapping*, which can apply texture bitmaps of varying resolutions as an object recedes from the viewer.

an application or game runs; that's the job of the CPU).

First, graphics commands issued by the application must be converted to a format consisting of *pixels*, or *picture elements*, each of which contains color and intensity information. The conversion is performed under Windows by the operating system's *graphics device interface (GDI)*, which manages communication between the software application and the graphics card.

Since the conversion to pixel format takes up a great deal of bandwidth, the

graphics card's *software driver* intercepts bitmaps or primitive drawing commands issued by the GDI in order to accelerate the processing. The driver passes the bitmaps directly to the graphics board, and it turns the GDI drawing primitives into the board's own primitive drawing commands. These primitives are then sent to the card to be interpreted by the graphics controller, rendered into the frame buffer, and ultimately drawn on-screen.

The use of 3-D adds another layer of complexity to this model, because it

assigns every object a set depth in *x, y, z* space (as opposed to a simple *x, y* grid). The appearance of objects on-screen therefore becomes a question of how far they are from the viewer, whether they're blocked by other objects and hence obscured from view, how far they are from various kinds of light sources, and how they're angled with respect to these vantage points—as well as how their surfaces are textured. All of these factors require many more calculations for each pixel than in 2-D, and that in turn requires much more processing power to drive it all at a reasonable speed.

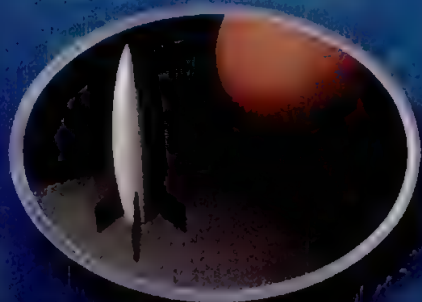
PIXELS AND POLYGONS

The basic structure of 3-D virtual worlds has become fairly standardized in order to provide a consistent framework for software development. All 3-D scenes are subdivided into polygons, usually triangles, which serve as surfaces of the objects being rendered. These polygons are defined in 3-D space by their corners, or vertices, which are assigned values for color, illumination, depth, fog, and texturing.

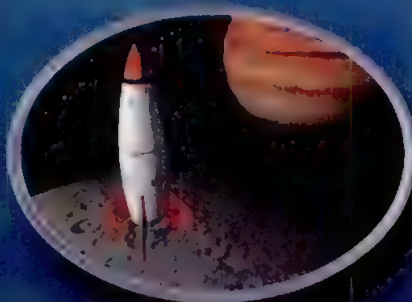
To conserve processing time, most 3-D applications avoid wasting calculations on objects that are blocked by other objects or on rear-facing surfaces that are not in view. Such optimizations usually take the form of back-facing polygon *culling* (removing triangles you'll never see face-on), *clipping* (removing polygons outside the field of view), and hidden-surface removal using a *z-buffer*.

Z-buffer memory stores the *z* (or depth) value of each pixel and then compares it with other pixels in the same area of the screen. Since there may be multiple objects at various depth levels at a given pixel's *x, y* location, the goal is to draw only those objects that are closest to the user, overwriting ones that are farther away on the *z*-axis but which are identically located on the *x, y* grid. This way, pixel information that gets sent to the frame buffer for eventual output to the monitor will only contain what's needed for presenting the image. Of course, storing all of those *z* values requires a great deal of memory; for this reason, many new graphics cards come with dedicated

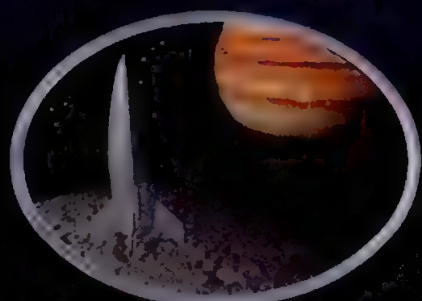
The Language of 3-D: A Visual Glossary



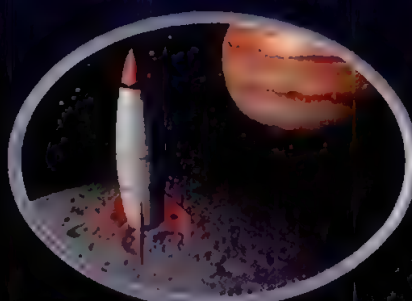
GOURAUD SHADING is an advanced shading method that allows curved surfaces and contours to appear rounded instead of faceted. It is an improvement over the more primitive flat shading, which creates a blocky effect.



IN TEXTURE MAPPING, a 2-D bitmapped image, stored in memory, is applied to a 3-D object to make its surface realistic (a wood-grain pattern applied to a door, bricks to a wall, the clouds to Jupiter, or craters to a moon).



TRANSPARENCY (also called *translucency*) enables the rendering of see-through objects such as water, glass, smoke, fire, and fog. Each pixel of a 3-D object can be assigned a translucency value, ranging from transparent to opaque.



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Specifying Graphics RAM

The amount of RAM you need on your graphics card depends on the resolution and color depth you plan to run. Here are our recommendations for the minimum RAM you should specify (to accommodate 3-D rendering, we recommend at least 4MB).

Resolution	Color depth		
	256 colors (8-bit)	65,000 colors (high color, or 16-bit)	16.7 million colors (true color, or 24-bit)
640-by-480	4MB	4MB	4MB
800-by-600	4MB	4MB	4MB
1,024-by-768	4MB	4MB	4MB
1,280-by-1,024	4MB	8MB	8MB
1,600-by-1,200	8MB	8MB	16MB

on-board z-buffer memory in addition to standard frame-buffer RAM.

DIRECT3D

Another important factor in the 3-D equation is the *API*, or *application programming interface*, which lets application developers take advantage of 3-D hardware. Traditionally, most games force you to switch into DOS, because DOS provides programmers with access to low-level hardware commands, while Windows historically has not provided that access. Microsoft has remedied this shortcoming with *Direct3D*, a programming interface that provides access to the frame buffer and other elements of the graphics card, finally allowing developers to create faster-moving games and animation without leaving Windows.

The newest games on the market are now D3D-compatible, but it isn't only gamers who should take note of the new API. Business users should also request 2-D/3-D cards, because they'll soon see applications like spreadsheets and presentation packages taking advantage of the new 3-D functionality.

HOW TO PICK 'EM

So which card should you buy? As for 2-D, our labs have shown performance to be very good across the board, no matter the vendor. But for the past two years, there has been a game of leapfrog in the 3-D arena as each vendor tops the others with a newer, faster 3-D processing engine. The 3Dfx Voodoo Rush chip set has been the one to beat in the gaming market, but we also found top performers

in the nVidia RIVA 128, the Rendition V2100, and the ATI 3D Rage Pro. New offerings from Matrox (the G200) and S3 (the Savage3D) claim to beat all comers.

For what it's worth, differences in 3-D will probably matter only to gamers for now. They'll need to see which particular chip or chips their favorite games recommend. (Games are usually optimized for one chip or another, since developers generally use the chip maker's own API and not D3D.) Business users will do fine with almost any of the current chips, provided they've added enough RAM.

The amount of RAM in the frame buffer is important because it determines the resolution and color depth you can run in a given 2-D frame. Gamers will also need extra RAM for 3-D rendering operations. If you're buying a card now, we recommend at least 4MB, so you can drive a 17-inch display at 1,024-by-768 resolution at *true color*

(16.7 million colors) and still have headroom for 3-D functions. Be sure the card's RAM is upgradable to 8MB, which will allow you to move to a 19- or 21-inch screen down the road and run it at a higher resolution (1,280-by-1,024, for example) without having to chuck your graphics card.

If you have a Pentium II machine, we recommend that you buy a card compatible with AGP, the new high-bandwidth graphics pipeline that takes graphics processing off the PCI bus. AGP is especially well-suited to 3-D rendering, since its unique texturing mode allows textures to be read from system memory and immediately applied to the scene, without first being copied to the frame buffer. Hence the system memory acts as an extension to the frame-buffer memory. Our labs have shown AGP boards to be slightly faster than their PCI counterparts. In addition, an AGP card frees up a valuable PCI slot.

Less essential but still fun are multimedia options like video-out ports that let you use the TV as a monitor for presentations or for big-screen gaming. Some graphics cards also come with a TV tuner so you can actually watch TV on the monitor itself. Several vendors sell add-on components for video capture and video editing, and you can also buy add-in DVD decoder boards, which allow you to watch movies encoded with MPEG-2 video and Dolby Digital sound on your PC.

Whichever card you buy, always keep your present needs in mind while at the same time staying prepared for future developments in this fast-changing market.

Specifying Scan Rates and Refresh Rates

Monitor makers list some arcane specifications in their literature. To simplify matters, find the resolution you wish to run on the left, and make sure your monitor supports the minimum vertical refresh rate and horizontal scan rate we cite.

If your desired resolution is...	...you'll want a vertical refresh rate of at least...	...so the horizontal scan rate needs to be at least...
640-by-480 (VGA)	85 Hz	43 kHz
800-by-600 (SVGA)	85 Hz	54 kHz
1,024-by-768 (XGA)	85 Hz	69 kHz
1,280-by-1,024 (SXGA)	75 Hz	80 kHz
1,600-by-1,200 (UXGA)	72 Hz	89 kHz

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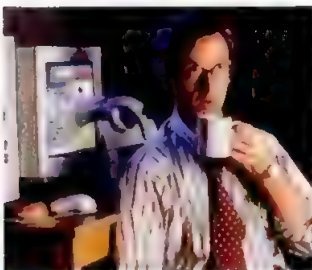
VENDOR	% WHO WOULD BUY THE SAME BRAND
Dell	92%
Quantex	91%
IBM	89%
Micron	81%
Gateway	80%
Acer	74%
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Toshiba	61%
Compaq	58%
Packard Bell	51%

Windows Magazine, 8/97

OVERALL RANKINGS Technical Support Survey

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Dell	
IBM	
Compaq	
Gateway 2000	Good
Micron	
Acer	
Toshiba	Fair
Digital	
Packard Bell	Poor

Windows Magazine, 8/97



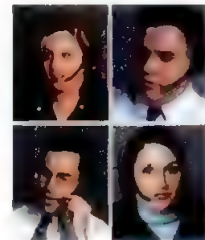
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PC World

15 Best Buy Awards
Oct '97 - Jun '98

Windows Magazine

WINLIST Award
QP6/233 SB-3
(03/98)

PC Computing

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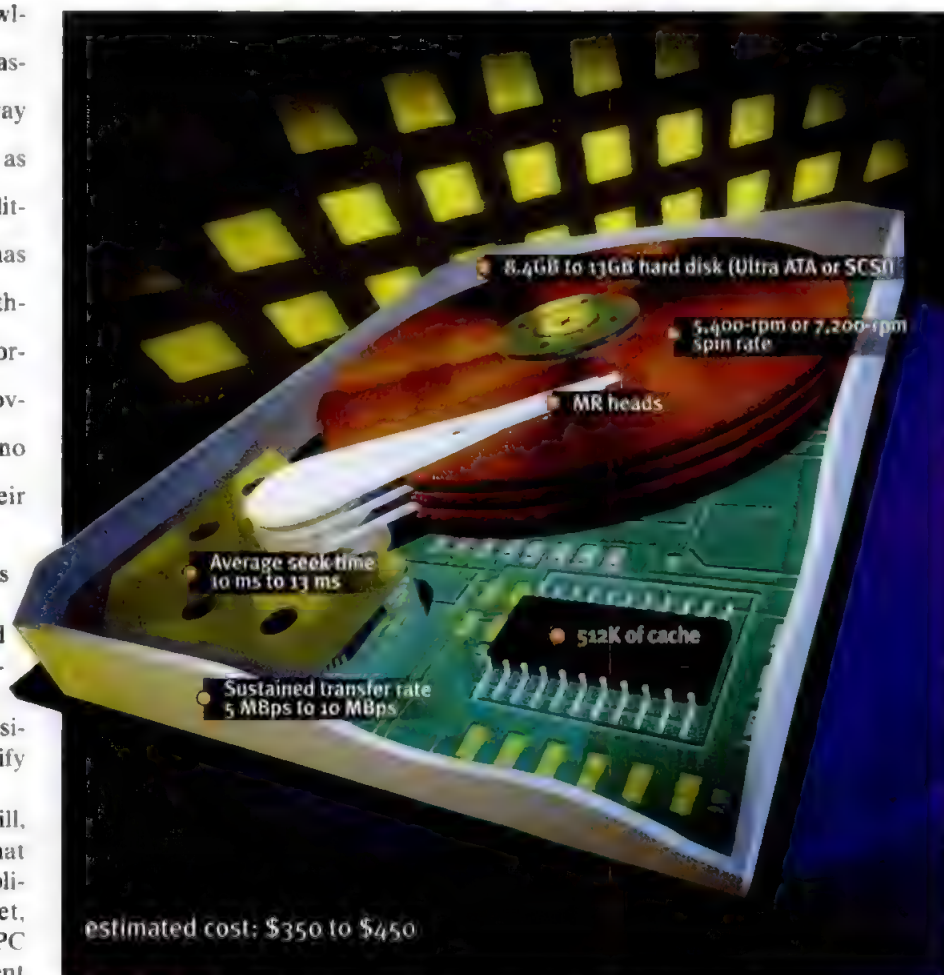
Hard disk capacity is growing by leaps and bounds, even in affordable machines. Need more space? Removable drives are better than ever.

By Jamie M. Bsals

Most PC users acknowledge that ever-increasing processor power has paved the way for advanced PC applications such as image processing and digital video editing. But few recognize that storage has played an equally important role: Without the gigabytes of fast, affordable storage that today's hard disks and removable drives deliver, there would be no place for the applications and their space-hungry files.

The capacity of affordable hard disks in particular has grown impressively. A year ago, our perfect PC came equipped with a 3.1GB hard disk. Today, a sub-\$1,000 machine should have a 4GB hard disk; for a more full-featured business or home PC, you should specify 8.4GB to 13GB.

Although this may seem like overkill, it isn't. The rule of thumb dictates that the operating system and standard applications (word processor, spreadsheet, browser, e-mail, and so on) on a new PC should occupy no more than 25 percent of the hard disk's capacity, leaving you 75 percent for noncritical applications (image editors, utilities, games) and all the associated data files. The full installation of Windows 98 eats up about 250MB, and the latest version of the Microsoft Office suite wants another 250MB. Figure in Internet downloads, image-laden business presentations, and photos from a scanner or digital camera and you'll see that 8.4GB is not such a



crazy number. If you plan to edit video or make CD-ROMs, you'll need free space to construct the files on your hard disk; go for 13GB.

Beyond capacity, you also need to consider performance. A number of factors determine the effective speed of a hard disk. Chief among them is the rotational speed of the platters: The faster the disks spin, the more data passes under the magnetic heads that read the

data. PC Magazine Labs tested three hard disks, with speeds of 5,400 rpm, 7,200 rpm, and 10,000 rpm. Although design differences keep the results from being directly comparable, we did find a noticeable improvement in transfer rates and benchmark test scores as we moved up the scale (see the table "How Much Faster Is Faster?").

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SONY

Removable Storage: Key Options to Augment a Hard Disk

FLOPPY DISK DRIVE REPLACEMENTS

HARD DISK COMPLEMENTS

	Iomega Zip	LS-120	Sony HiFD	CD-R/CD-RW	SyQuest SparQ	SyQuest SyJet	Iomega Jaz	DVD-RAM, DVD-RW
Capacity	100MB	120MB	200MB	650MB	1GB	1.5GB	1GB, 2GB	2.6GB, 3.6GB
Street price	\$150	\$80-\$120	\$200	\$400-\$700	\$200	\$300	\$280-\$550	\$800*
Media price (cost per MB)	\$15 (15¢)	\$14 (13¢)	\$20 (10¢)	\$4-\$15 (1¢-4¢)	\$33 (3¢)	\$66 (4¢)	\$100-\$170 (8¢-10¢)	\$30 (1¢)*
Sustained write/read rate	1,100 KBps/ 1,100 KBps	290 KBps/ 290 KBps	1,200 KBps/ 3,700 KBps	300 KBps/ 175 KBps	3,700 KBps/ 7,000 KBps	5,700 KBps/ 5,700 KBps	7,350 KBps/ 7,350 KBps	1,340 KBps* / 1,340 KBps*
Major vendors	Iomega	Compaq, Imation, Mitsubishi	Sony	Hewlett-Packard, Philips, Sony, Yamaha, others	SyQuest	SyQuest	Iomega	DVD-RAM: Panasonic, Toshiba; DVD-RW: Philips, Sony
Pros and cons	Wide acceptance makes it easy to share data with others; portable; 100MB is less than newcomers' capacities.	Backward-compatible with 3.5-inch floppy disks; unproven market acceptance.	Backward-compatible with 3.5-inch floppy disks; unproven market acceptance; very new to market.	Can be used to create data and music disks that most CD drives can read, making it an ideal distribution medium.	Good capacity, fast; an excellent value. Hard to beat.	Good capacity, fast; an excellent value. Hard to beat.	Good capacity, fast, popular; a good choice.	Will read DVD-ROM disks and all CD formats. But the competing and incompatible standards muddy the writable DVD waters.

* Projected.

adequate for typical applications. If you work with video for a living, you'll want to trade up to a 7,200-rpm disk, as the extra speed will ensure that you don't drop frames in record or playback. The new 10,000-rpm disks (and the coming 12,000-rpm screamers) are really meant for high-performance servers: The high rotational speed generates more heat than a typical desktop PC case can dissipate efficiently, and the drives themselves tend to be noisy.

Another important specification is the hard disk's *average seek time*, the time the unit takes to position the head over the desired track. Look for a manufacturer-rated seek time of 10 ms (milliseconds) to 13 ms. Most vendors also cite a rating for *average access time*, the time it takes to position the head over a particular sector. Look for an access time of 18 ms or less.

One figure that can cause confusion is the claimed transfer rate, cited in megabytes per second (MBps). Some vendors list the *internal transfer rate*, the rate at which the disk moves data from the head to its internal buffers. But some vendors cite the *burst data-transfer rate*, the maximum transfer rate the disk can attain under ideal circumstances and for a short duration. More important for the real world is the *external transfer rate*, or how fast the hard disk actually transfers

data to your PC. Look for a sustained external data-transfer rate of 5 MBps to 10 MBps.

Finally, the interface the unit uses to connect to your PC affects disk performance. Most desktop hard disks use the standard IDE bus interface, also called ATA. (See the section "Interfaces" in this story.) IDE is inexpensive to implement, and the bus's transfer rate—a minimum of 3.3 MBps, but typically much higher in newer PCs—does not create a bottleneck for everyday computing tasks. Hence an IDE hard disk is fine for most typical office chores.

For high-performance applications and servers, however, you'll want a SCSI hard disk connected to your PC's SCSI bus. SCSI's higher bandwidth can accommodate the transfer rates you'll get from a 7,200- or 10,000-rpm disk.

No matter what your hard disk's

capacity, you'll probably want to opt for some type of removable storage to augment the fixed disk. A drive with removable disks or cartridges gives you unlimited storage space and lets you off-load noncritical applications and files that you don't want to part with. A removable drive also makes it possible to back up critical data in case your hard disk crashes, share data with others, shuttle large files between home and office PCs, and lock up sensitive data at night.

A wide range of removable drives are available, and we break them down roughly into two categories: floppy disk replacements, which aim to replace the inadequate 1.44MB floppy disk drive, and hard disk complements, which offer capacity of 1GB or more and performance that rivals that of hard disks. We present the most significant of each class on the accompanying table.

How Much Faster Is Faster?

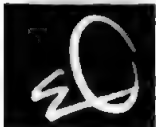
PC Labs tested drives of different speeds to measure real-world performance gains.

	Best measured transfer rate Thousands of bytes per second	ZD Business Disk Win-Mark 98 Thousands of bytes per second	ZD High-End Disk Win-Mark 98 Thousands of bytes per second	ZD Business Winstone 98 Score
Quantum Fireball, 5,400 rpm	9,495	1,100	3,090	22.8
Seagate Barracuda, 7,200 rpm	15,100	1,630	4,500	23.7
Seagate Cheetah, 10,000 rpm	17,400	2,100	5,375	24.3



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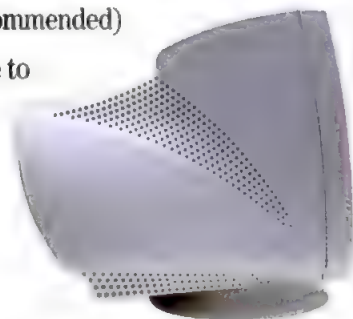
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EO700	17"	15.95"	0.28mm - FST	1280	120Hz
EO710	17"	15.95"	0.26mm - High Contrast	1280	120Hz
EO720	17"	15.95"	0.26mm - MicroFilter™	1280	120Hz
EO90	19"	18.0"	0.26mm - High Contrast	1600	150Hz

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Multimedia

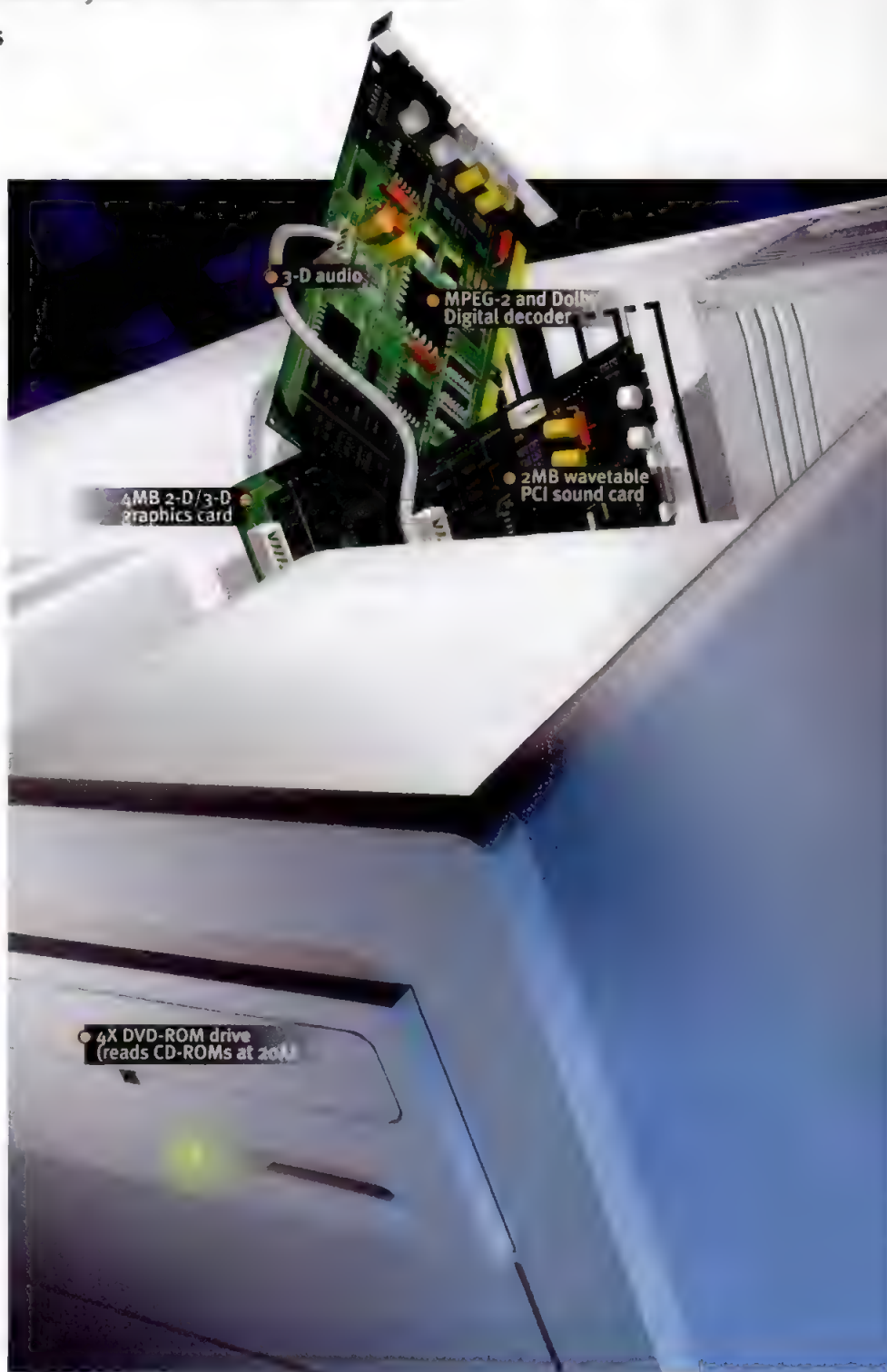
Blame it on DVD and sound: No components are more in flux right now than those that control your PC's multimedia features.

By Jamie M. Bsales

Say good-bye to CD-ROM. After almost ten years as the centerpiece of PC multimedia, the CD-ROM drive is being supplanted by DVD-ROM. In addition, several initiatives are under way to improve the audio quality of PCs greatly. But though things are changing rapidly, we can make some firm recommendations for the perfect multimedia subsystem.

First and foremost: If you're buying a new PC, get it with a second-generation DVD-ROM drive. DVD disks can hold 4.7GB of data (versus just 650MB for a CD-ROM), which lets developers deliver video-rich multimedia encyclopedias, interactive games, huge databases, and even full-length motion pictures (as a bonus, the movie disks are compatible with the home DVD players that connect to your TV). The first generation of DVD drives for the PC could read DVD disks (at 1X speed), CD-ROM disks (at up to 12X speed), and audio CDs. They couldn't, however, read the CD-R (compact disk-recordable) and CD-RW (compact disk-rewritable) disks made by recordable drives. So if you needed access to data that someone gave you on a homemade disk (an occurrence that is becoming more common as the popularity of the recordable drives grows), you still needed a separate CD drive.

So you'll want to specify a second-generation DVD drive—also referred to as a DVD-2 drive—since such drives offer multiread capability, which gives you access to all CD formats. These newer



drives also deliver increased speed: You'll get 2X to 5X read speed for DVDs and up to 24X for CDs. A DVD-2 upgrade kit that lets you replace or augment your current CD-ROM drive costs around \$400 on the street. DVD will typically add \$250 to the price of a new PC, so sub-\$1,000 shoppers will need to stick with CD-ROM for now.

The cost of entry for DVD will drop in the coming year as volumes increase and as the need for a *decoder card* disappears from some systems. Right now, most DVD solutions include a separate PCI card to handle the decoding of the MPEG-2-

encoded video and the Dolby Digital surround-sound audio that are standard elements of DVD multimedia content (see below for more on Dolby Digital).

Several vendors are working to eliminate that card, however; it adds about \$50 to the price you pay to trade up to DVD. Both Intel Corp. and Zoran Corp., for example, now offer software MPEG decoders that can work in conjunction with a standard graphics accelerator to handle MPEG video. The catch: Such schemes rely heavily on the CPU for smooth playback, so you need a powerful processor (preferably a 300-MHz or better Pentium II CPU) to assist with the decoding and keep other operations, such as input from the mouse or keyboard, running as well. So expect hardware and software solutions to coexist for the next couple of years, as well as hybrid schemes that use some of each.

The other half of the multimedia equation is sound, and there is just as much activity on that front. This year the big news is the move to the PCI bus of the sound card, which has traditionally resided on the ISA bus. But ISA's days are numbered, and the industry is gradually phasing out the ISA bus in favor of the more robust PCI bus. In fact, Microsoft's PC98 specification decrees that new Microsoft logos will not be issued to ISA-based audio solutions after January 1, 1999.

Moving audio to PCI reduces CPU utilization, allows more sounds to be played concurrently, and gives sound card makers the bandwidth to implement advanced audio schemes, most notably 3-D positional audio.

Such audio lends more realism to games and movies. Imagine the sound of a helicopter that seems to be moving overhead or the breathing and footsteps of a monster sneaking up behind you.

Schemes that debuted a few years ago, most notably from Spatializer and SRS, are found in many sound cards and speakers. These deliver an enhanced stereo image to give the illusion of surround sound, but they fall short of the newer systems. The most popular of the new surround-sound codecs, bolstered by DVD's emer-

gence, is Dolby Digital (formerly called AC-3). This standard delivers so-called *5.1-channel audio*: five midrange speakers (front left and right, center, rear left and right) and a subwoofer (the ".1").

Dolby Digital lets your PC deliver the truly immersive sound you get from a home theater system. To get Dolby Digital, the game or movie must have been recorded using the 5.1-channel arrangement, and you'll need a sound card and speaker set that can deliver those channels. The most effective setup (used by Cambridge SoundWorks and others) is to place six discrete speakers around your chair. Other systems (most notably those from Altec Lansing Technologies) try to deliver the surround-sound effect with just two speakers and a subwoofer; the effect is not as good as with six speakers, but for most PC users this setup is a lot more practical.

Another 3-D sound technology popular with game developers is Aureal's A3D, because it enables interactive 3-D sound that changes as the player moves around the virtual world. Developers can construct their games or other multimedia titles using the A3D API (application programming interface), and end users who have A3D-compatible hardware (either a sound card or speakers) will then get the surround-sound effects the developer intended. Similar APIs are available from Microsoft (DirectSound3D) and Qsound Labs (QSurround), though A3D has the jump on market acceptance.

Note that all of these schemes are really targeted at PC gamers and those who will watch DVD movies on their PCs. For typical business use, all you need is a good pair of speakers with an added subwoofer (\$100 to \$200 total).

One thing that hasn't changed is the type of sound reproduction to look for. The perfect PC will have a card that delivers at least 2MB of wavetable sound samples. *Wavetable synthesis* is a sample-based synthesis that uses short recordings of actual instruments (and other natural sounds) that the audio processor can manipulate to create the sounds and music an application calls for. It has all but replaced the artificial-sounding *FM synthesis* used on the first PC sound cards, which attempted to reproduce the sounds electronically—and hence sounded like a 1980s-era arcade game.



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Interfaces

There's more to a PC than just processors, cards, and drives. Every component is connected to an interface with its own characteristics.

By Josh Levy

To build the perfect PC, you need more than just the finest components; top-quality performance calls for the right peripheral bus as well. Today, many sluggish interfaces left over from earlier eras have been updated or replaced, and lightning-fast new ones are on the horizon. It's worth your while to cut through the confusion and learn about the most common ones, because as the saying goes, a chain is only as strong as its weakest link.

The most familiar interfaces are probably ISA and PCI, used for add-in boards such as graphics cards, sound cards, and modems that fit into slots on your motherboard. ISA, or *Industry Standard Architecture*, is a legacy of the DOS era. Today's incarnation has 16-bit data width and carries up to 8.33MB of data per second, in theory (in practice it's more like 2MB to 3MB). Although attempts have been made to replace or upgrade this bus (MCA, EISA), it is still commonly used for devices such as sound cards. That is changing, however, as the industry has chosen to phase ISA out gradually in favor of PCI, the *Peripheral Component Interconnect*. PCI is a 32-bit local bus that runs at 33 MHz and carries data at up to 133 MBps—an enormous leap over ISA. A newer 64-bit, 66-MHz version of PCI that can transfer data at up to 266 MBps will soon appear in high-end systems.

Intel Pentium II PCs now implement another port specifically dedicated to graphics. Titled AGP for *Accelerated Graphics Port*, this interface provides direct

pipelined access between the graphics card and system memory, allowing for transfer rates of up to 528 MBps and greater ease in performing complex 3-D operations. In addition, by removing graphics from the system bus, AGP frees up an additional PCI slot for other devices, such as sound cards that are migrating from the ISA bus.

For storage components such as hard disks, CD-ROM drives, and tape drives, the most common and least expensive interface is the ATA or IDE bus. ATA, for *AT Attachment*, refers to the original design for connecting peripherals to IBM AT machines in the 1980s; IDE stands for *integrated drive electronics*.

The terms are used interchangeably.

The ATA/IDE bus uses two different methods for communicating with the host computer. One is DMA, *direct memory access*, which moves data directly to the system RAM without passing it through the CPU. This technique is limited by the speed and bandwidth of the motherboard's system bus. The other method, PIO (*programmed input/output*), uses the CPU's registers for transferring data. Historically, PIO speeds have been able to increase as faster processors came to market, while DMA has been hamstrung by the bottleneck of unchanging system buses. However, the advent of faster bus

Interfaces at a Glance

	Typical uses	Burst data-transfer rate	Outlook
INTERNAL PERIPHERALS			
ISA	Sound cards, modems	2–8.33 MBps	Phased out by late 1999.
EISA	Graphics cards, SCSI adapters	33 MBps	Almost entirely phased out; replaced by PCI.
PCI	Graphics cards, SCSI adapters, new sound cards	133 MBps (new version, 266 MBps)	Standard add-in peripheral bus for the foreseeable future.
AGP	Graphics cards	528 MBps	Standard in all Intel-based PCs starting with the Pentium II; coexists with PCI.
STORAGE AND EXTERNAL PERIPHERALS			
ATA/IDE	Hard disks, CD-ROM and DVD-ROM drives	3.3–33.3 MBps	Standard hard disk bus for the foreseeable future.
SCSI	Hard disks, removable drives, scanners	5–80 MBps	Standard high-end hard disk bus for the foreseeable future.
USB	Pointing devices, sheet-feed scanners, cameras	12 Mbps	May eventually replace serial and parallel ports.
1394	Digital video cameras, high-speed storage drives	400 Mbps	Will become common in high-throughput devices by the end of 1999.
PORTABLE PERIPHERALS			
PC Card	Laptop peripherals (modems, network adapters, hard disks, more)	8 Mbps	Being gradually phased out in favor of CardBus.
CardBus	Laptop peripherals (modems, network adapters, hard disks, more)	132 MBps	Current 32-bit laptop peripheral standard; will replace PC Card.

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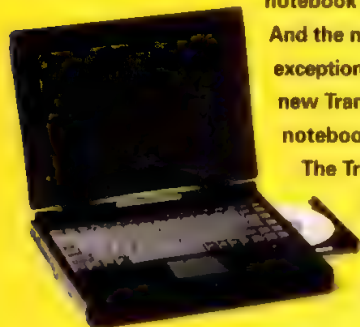
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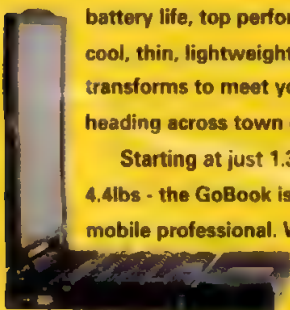
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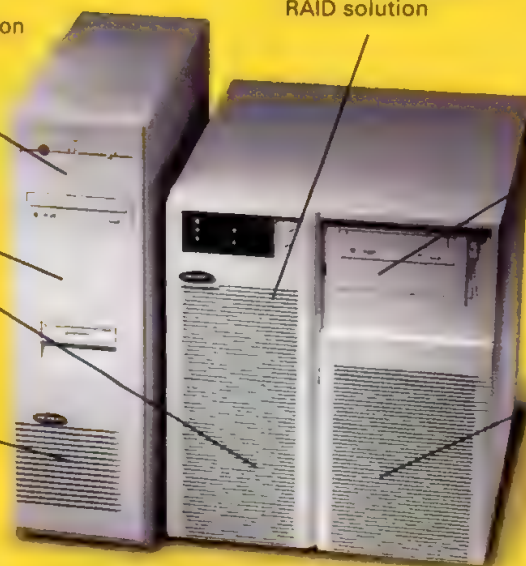
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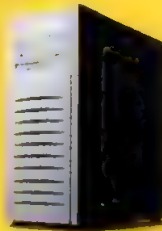


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architectures like EIDE (*Enhanced IDE*) and PCI gave rise to faster DMA. Today there are a multitude of PIO and DMA modes, and all new hard disks support more than one of these.

The fastest ATA/IDE disks today are Ultra ATA drives, also known as Ultra DMA and ATA-4. These support throughput of up to 33 MBps between the hard disk and system RAM, but only in conjunction with new motherboard chip sets such as those found in the latest Pentium and all Pentium II machines. Bear in mind that all such figures are maximum attainable data burst rates; some disks that share the same maximum burst rate will have different sustained data rates.

The highest-end hard disks in the desktop PC market eschew the ATA/IDE bus in favor of the faster SCSI (*small computer system interface*), which is also used in Apple Macintosh PCs. SCSI technology can support more attached peripherals on a single channel and is more efficient than IDE. While SCSI is fast, a SCSI interface card adds cost to a PC, and SCSI peripherals (such as drives and scanners) typically

With support available in Windows 98, vendors should start delivering more USB peripherals.

cost more than their IDE equivalents. Still, for servers, RAID subsystems, or power-user PCs, SCSI is a nice addition.

There are several other interfaces worth noting that will become commonplace in the near future. The most widely hailed is USB, or *Universal Serial Bus*, a 12-Mbps channel designed to replace the various interfaces that connect external peripherals such as pointing devices, sheet-fed scanners, and digital cameras to your PC. Hubs that offer up to four USB ports are available now, and most major monitor makers now offer models with USB ports built-in; both solutions save you the hassle of reaching around the back of your PC to connect and disconnect components. USB has been

a standard feature of many motherboards for two years, but it has been slow to take hold because of spotty OS support. With full support available in Windows 98, however, hardware makers should soon start to deliver many more USB peripherals.

Hot on USB's heels is IEEE 1394, which started on the Macintosh side of things as FireWire. With bandwidth of up to 400 MBps, it's ideal for such high-throughput electronics products as digital camcorders, and some vendors are considering it as an alternative to SCSI for hard disks. Expect 1394-equipped PCs to begin appearing this summer, with compatibles arriving in numbers late this year and throughout 1999.

One intriguing recent industry development is a design specification that would standardize all peripheral connections. Called *Device Bay*, it would allow for easy swapping of major components like hard disks and CD-ROM drives without messing with complicated cables. A Device Bay connection would use either USB or IEEE 1394 as the interface and could accommodate virtually any peripheral. **PC**



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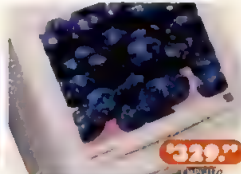
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High-End Notebook

The power gap between notebooks and desktops has closed again, and most high-end systems have all the power needed to be your primary PCs.

By Robert S. Anthony

Thanks to Intel's recently released 233-MHz and 266-MHz mobile Pentium II processors, you'll find today's high-end notebooks are hardly word processors or simple number crunchers: They have the multimedia muscle, the processing power, and the data capacity to replace your desktop system.

Until recently, most high-end notebooks cost \$5,000 to \$7,000, but both technological advances and competition have lowered costs across the board. Although the top systems still cost about \$5,000 (or more), you'll find many notebooks loaded with all the high-end features you need at \$3,500 or less. What you'll give up at the lower price range is specialized features such as both NTSC video-in and -out ports for presentations on TV monitors or accepting input from a TV feed, bundled DVD drives, graphics solutions with hardware MPEG2, the most robust sound solutions, or the largest screens (14- or 15-inch versus 13.3) and hard disks (8GB versus 6GB). Most full-featured systems weigh between 7 and 8 pounds, although a few are coming in at under 7 pounds.

CORE COMPONENTS

Intel's new mobile Pentium II is the most powerful processor available for portables. This chip provides nearly 20 percent more Winstone performance than same-speed Tillamook (low-power) mobile Pentium MMX chips. But there is a trade-off in bat-



tery life: The best Tillamook-based systems yield over 4 hours of life, whereas the best mobile Pentium II units lag by nearly an hour. Both chips are built using the 0.25-micron process; mobile Pentium IIs have a 1.7-volt core and draw about 8 or 9 watts (the latter is on a par with pre-Tillamook mobile Pentium MMX chips), and Tillamook CPUs run at 1.8 volts internally and draw less than 7 watts.

High-end notebooks offer stunning 14-inch XGA TFT displays with visible areas between

those of typical 15- and 17-inch CRTs. Brilliant 15-inch displays are here. But some users may find that units with 15-inch displays are too large and bulky if they truly intend to take their notebooks traveling.

The graphics chip sets available for notebooks still lag behind those on your desktop, and the fastest TFT LCD still can't keep up with the refresh rate of a CRT. All the same, a 128-bit 3-D mobile graphics chip set with 4MB or more of

video memory is hardly an under-

powered graphics solution. Although AGP (Accelerated Graphics Port) solutions aren't ubiquitous, they should be by the end of this year; because of the complexity of the chip set, there may be an impact on battery life.

Get a system with 64MB or more of SDRAM: It may seem like overkill, but upcoming Windows 98 and Windows NT 5.0 applications will require the room. Your storage options keep improving: You can get up to 8GB on an ultrathin hard disk; 10GB disks will be ready by year's end.

OPTIONS

Many top notebooks offer one or more modular drive bays that let you decide what to take with you: a floppy disk drive, a CD-ROM or DVD drive, or a high-capacity cartridge storage module. Often, these drive bays also support second or even third batteries. Modular bays typically come in two sizes: 17-mm and 12.5-mm (the latter are most often found in lightweight or subnotebooks). Only 17-mm bays currently can hold DVD drives.

High-end 3-D wavetable audio with a built-in microphone and a full set of audio jacks is important for on-the-road presentations. Look for MIDI ports as well.

Your high-end notebook should have a 4-Mbps IR port that lets you synchronize data with handheld PCs and PDAs or send jobs to compatible printers. An integrated 56-Kbps V.90 voice modem and an integrated Ethernet controller are terrific conveniences. Traveling with a good portable color printer (typically 2 to 3 pounds) will also come in handy.

PC Card slots with CardBus (a PCI-level interface for PC Cards) and Zoomed Video (a high-speed 27-Mbps direct port from graphics memory to compatible external video devices) should be standard. The presence of a USB port, however, will prove far more important, especially with Windows 98, which has built-in USB support. A small USB videoconferencing camera and accompanying software can make your travels more productive. New USB peripherals, such as digital still cameras, are also on the horizon.

Corporate notebook users may expect management features such as DMI 2.0 support and security features such as password protection and a security slot for an encrypted card, for example.





Value Notebook

Price cuts and the new Pentium II mobile chip mean that frugal notebook shoppers with a \$2,000 budget will find systems loaded with features.

By Robert S. Anthony

At this price level, notebooks are aimed at users who need moderate word-processing, e-mail, and number-crunching capabilities. The notebooks are not meant to be primary PCs—although many have the power to be. Most units with Intel's mobile Pentium II CPU do not yet fall into this price range, but systems with top mobile Advanced Micro Devices (AMD) or Pentium MMX CPUs are currently available.

Active-matrix or dual-scan displays measuring 12.1 inches or larger dominate the offerings. New High Contrast Addressing passive-display technology offers close-to-active-matrix visual quality at a lower cost and at lower power consumption. You can expect a 4GB hard disk, 32MB of system RAM, and a 64- or 128-bit graphics chip set with 2MB of video memory.

You won't find integrated networking in value units, but you may find integrated 56-Kbps V.90 voice modems and high-quality wavetable audio support with stereo speakers and a full set of audio jacks. Devices such as CD-ROM drives and floppy disk drives may be fixed (as opposed to swapping out of modular bays), or CD-ROM drives may be combined with floppy disk drives into single modules. This keeps costs down, and many IS managers and users may find that it's more convenient to have multiple devices built in (fewer pieces to carry and lose).

Many value notebooks come with lithium ion batteries. Less-expensive nickel hydride batteries offer less life per pound and must be replaced earlier than lithium ion versions.



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Lightweight Notebook

It's amazing what you can do with less than 4 pounds of hardware: Even the thinnest subnotebook system packs in the power.

By Robert S. Anthony

Lightweight or subnotebook systems pack a formidable punch in 4-pound packages. Intel's Pentium MMX chips are most common, but you should find some systems with the new mobile Pentium II if you need that kind of power. There is a trade-off in battery life, however: Pentium MMX systems last 10 to 20 percent longer than Pentium IIs. Make sure you have a system with a lithium ion battery, which provides more power per pound than a nickel hydride model.

Lightweight systems have floppy disk, CD-ROM, and high-capacity removable cartridge options, but these devices are usually external. If you need an internal CD-ROM or floppy disk drive, look for a new class of lightweight units—adding less than a pound, on the average—that offer these devices in swappable bays.

Many subnotebooks offer full-size keyboards, but some do not. Anything less than a 90 percent-size keyboard may leave your fingers feeling cramped. A 10.4- to 12.1-inch active-matrix SVGA display is sufficient and a 5GB hard disk offers ample storage.

An integrated 56-Kbps V.90 voice modem is a fine plus. Also look for a USB port and two PC Card slots. A 4-Mbps infrared port is helpful for synchronizing data with PDAs and handheld PCs, and occasionally, for printing.

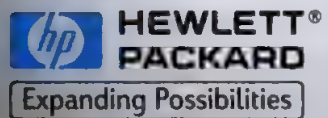
There is also a class of 2- to 3-pound mini notebooks with screens smaller than 10 inches, compressed keyboards, slower processors, and smaller hard disks for those looking for the most portable package to perform tasks on the road.



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HP IN HIGH-PERFORMANCE PC WORKSTATIONS



Connections

Getting work done on the road depends on connectivity. Back at the office, a port replicator or docking station can speed and ease your work.

By Robert S. Anthony

As you're traveling, reliable communication can make the difference between getting the job done and missing the deadline and the sale. One key to connectivity, PC Cards (formerly known as PCMCIA cards), has come a long way since the first spec was released in 1990: No longer do you have to struggle with configuration and drivers; most notebooks are truly able to plug and play. Keep handy at least a 56-Kbps modem; wireless versions, which can be connected to cell phones (though transmission speed drops), are increasingly useful. Wireless Ethernet cards can

make reconnecting back at the office a snap, and for those who would rather carry just one PC Card, there are combination modem/ LAN cards.

Port replicators (\$100 to \$200) and docking stations (\$250 to \$500) offer you both convenience and augmented capabilities. With a port replicator, you don't have to connect and unplug your notebook from the external monitor, keyboard, or mouse you use at the office; just disconnect the replicator. A port replicator duplicates all of your notebook's ports (including IR) and may add a second USB port or a SCSI port. USB ports, with their built-in intelligence and speed, are becoming more important as more USB devices, ranging from speak-

ers to cameras and scanners, hit the market. Windows 98 will have built-in USB support, which will further encourage the release of many new devices. A SCSI port lets you connect to such devices as external removable cartridge systems.

To enhance your notebook's capabilities, get a docking station. Docking stations replicate the ports on your notebook and may add extras such as SCSI or Ethernet ports. Many also offer better-quality stereo speakers, ISA or PCI slots, and drive bays for additional storage. A growing number also feature modular bays, which can hold devices such as your notebook's CD-ROM or DVD drive, an extra battery, or a high-capacity cartridge drive.



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Hand-Helds

A spate of new products and categories have kept well-deserved attention on the hand-held market. Products you can really use are here—now.

By Anush Yegyzarian

With the success of the 3Com PalmPilot—and Microsoft's broadened application of Windows CE—the hand-held market has become more legitimate. Your choice of devices has never been greater, from \$180 smart PC Cards to units in the familiar \$370 PalmPilot format, \$300 to \$850 cellular phones that aren't just phones, and your more traditional \$600 to \$900 clamshell hand-held devices with built-in keyboards. All these devices have different trade-offs in storage capacity, available applications, battery life, and size. For example, the

thought of one device—your cell phone—handling your organizer, pager, and communications functions is very appealing. But you'll find that some cell phones have no local storage, that the full set of services is not available in all areas, that all-in-one devices are bulky, and that their keyboards are difficult to use. Costs can also get high, because you pay not only for the device but for all the services to use it.

Microsoft-backed Auto PCs (A/PCs), running Windows CE, are also on the way. A/PCs will take the space now held by car stereos, and will offer audio functions, respond to

speech commands, and interact with *global positioning system* (GPS) devices for navigation and route mapping. They were expected this summer but have been pushed back to year's end or possibly early 1999. Intel is working on a similar concept, the Connected Car.

A 2-pound class of Windows CE devices (\$1,000 to \$2,000), code-named Jupiter, is beginning to make an appearance. These systems have keyboards closer to full size and offer the full range of applications of other Windows CE devices. That makes them well suited to travelers who need connectivity and plan to write or edit documents but have no need for the power—or weight—of a true notebook. **PC**

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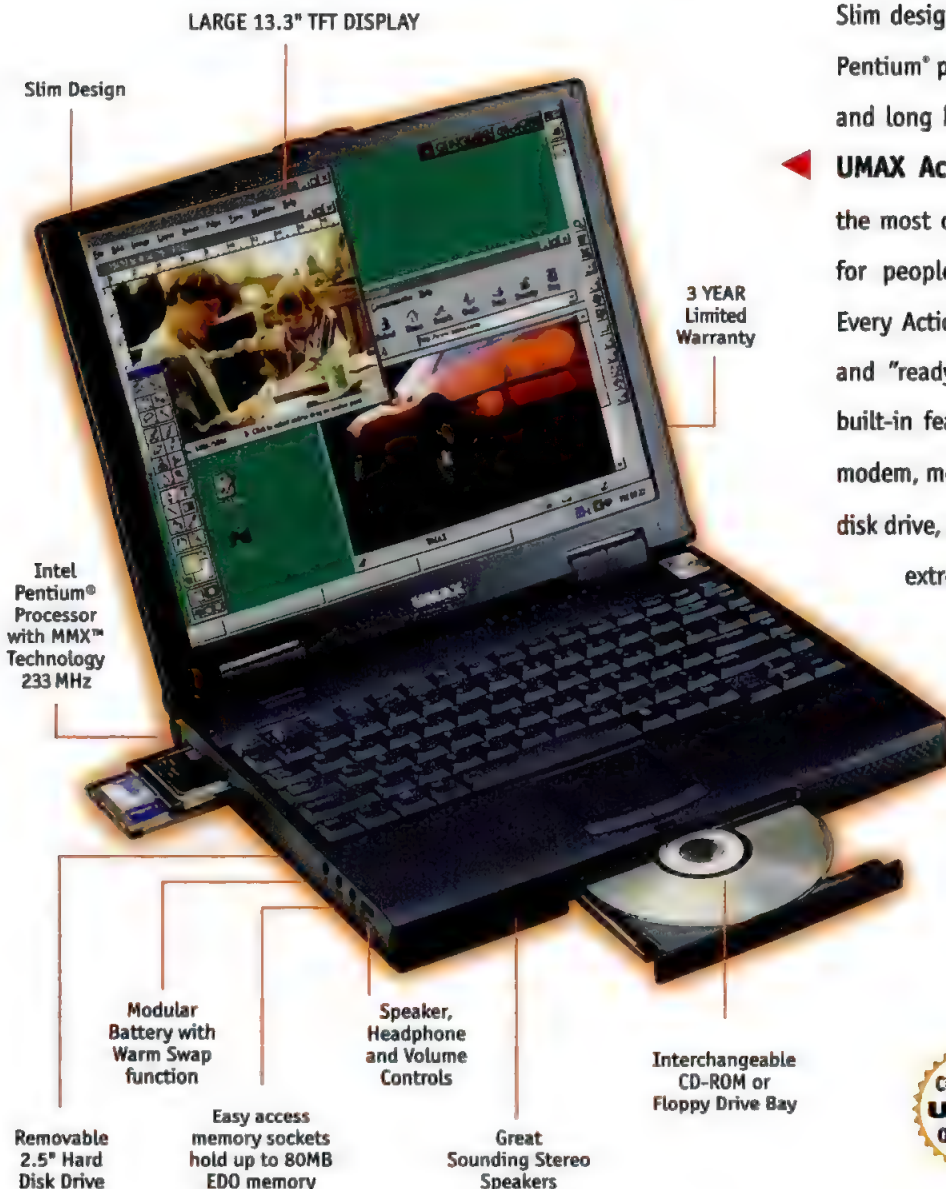
- **PROS:** Lightweight; holds all PIM data; easy sync with desktop; offers e-mail and notepad; lots of applications and accessories.
- **CONS:** Lacks keyboard; All data must be entered either using a virtual keyboard or through the unit's handwriting recognition software.

- **PROS:** Has color support; built-in keyboard makes data entry more convenient; offers broader range and more full-featured applications than a palm device; greater storage and voice-recording capabilities.
- **CONS:** Larger and bulkier than other types; battery life is significantly shorter, especially for color devices. Built-in keyboard is small and may be difficult to use.

- **PROS:** Ultraportable, long-life device fits in wallet and carries all PIM data.
- **CONS:** Read-only device; All data must be entered through PC and synchronized; lacks broad application support.

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Enterprise

Building a network that links your regional offices with those overseas demands the right mix of connections.

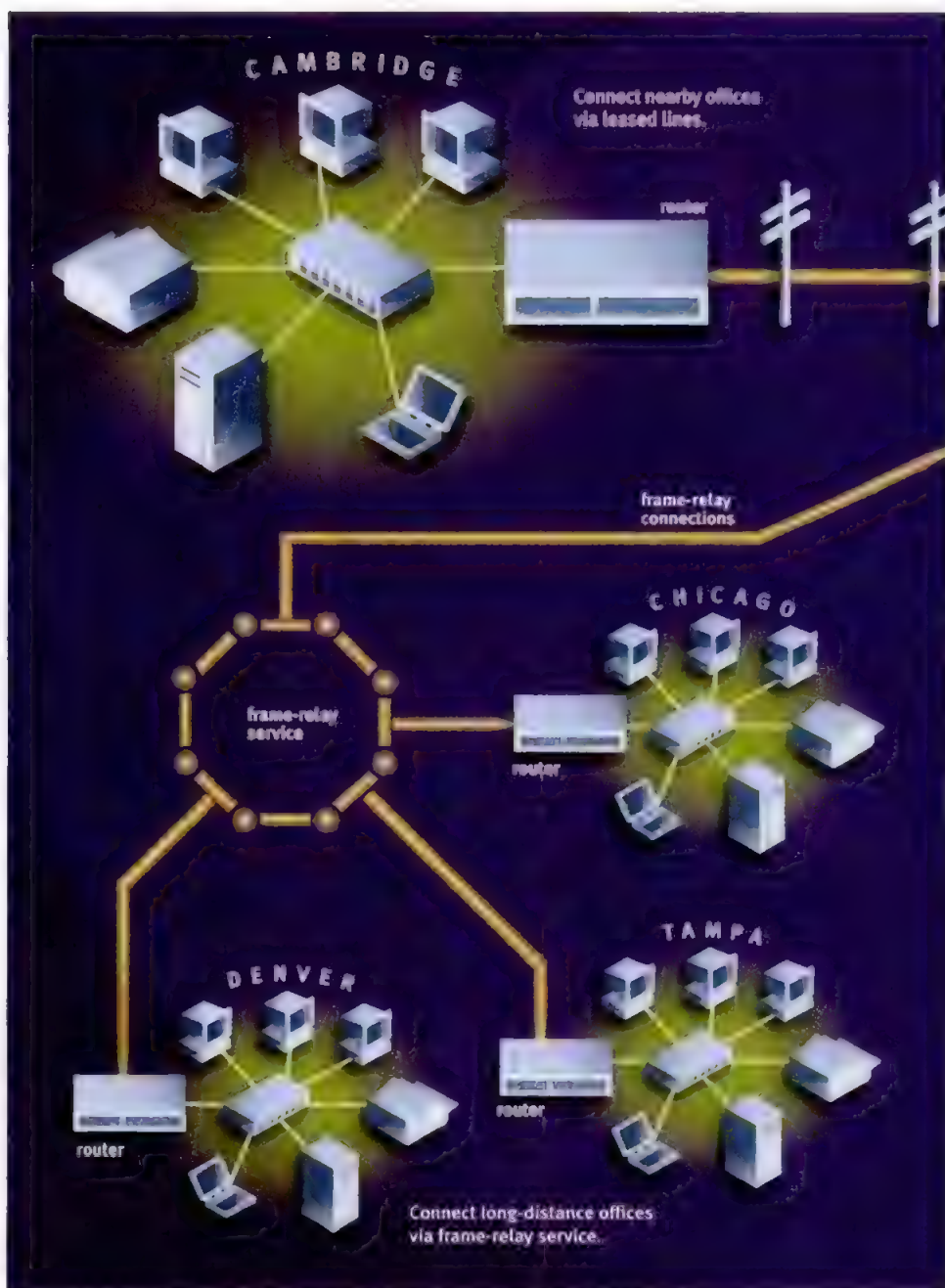
By Frank J. Derfler, Jr.

Think of an enterprise network as a series of links between LANs. The Perfect Enterprise balances cost, capacity, and reliability by providing a mix of leased lines, frame-relay service, and virtual private networks (VPNs). Knowing when to implement each connection method is key to building a flexible and robust network.

With its speed and flexibility, leased-line service is the best choice for connecting LANs less than 50 miles apart. Telephone companies offer point-to-point circuits that provide connection speeds ranging from 64 Kbps to over 45 Mbps. These dedicated lines are typically leased as fractional T1 channels (64 Kbps), T1 channels (1.544 Mbps), or T3 links (45 Mbps). But because the service is both distance- and bandwidth-sensitive—meaning you pay by the mile as well as by the bit—it can be expensive. Although leased-line pricing varies among carriers, you can expect to pay around \$2,000 per month for a T1 line that traverses 50 miles.

You can connect your New York and Chicago offices using a leased line, but the perfect enterprise uses a frame-relay service to connect LANs across long distances. Frame relay provides the T1 speeds of a leased line but at a flat rate, making it a much more cost-effective solution.

A frame-relay service divides information into frames of data that it transmits using packet-switching technology. The



method is flexible, because the frames can be any size, can include any protocol-control data, and can transmit any network protocol. Frame relay takes full advantage of T1 speeds by reducing unnecessary overhead on each frame of data. And because frame relay transmits data in bursts and uses bandwidth only when actively transmitting frames, it can be more efficient than leased lines.

LANs typically access a frame-relay network at 1.5 Mbps via a short leased line. You contract with a frame-relay provider for specified levels of bandwidth, but you

can temporarily surpass your contracted data rate as business conditions change.

Because a VPN links your LANs via an Internet connection, it is often the most cost-effective method for connecting offices outside the United States. VPN software encapsulates network packets, then securely tracks and delivers them via TCP/IP. And since many systems beyond North America place high tariffs on calls, you can easily show a cost savings with a VPN, which circumvents international phone companies.

To guarantee bandwidth and provide

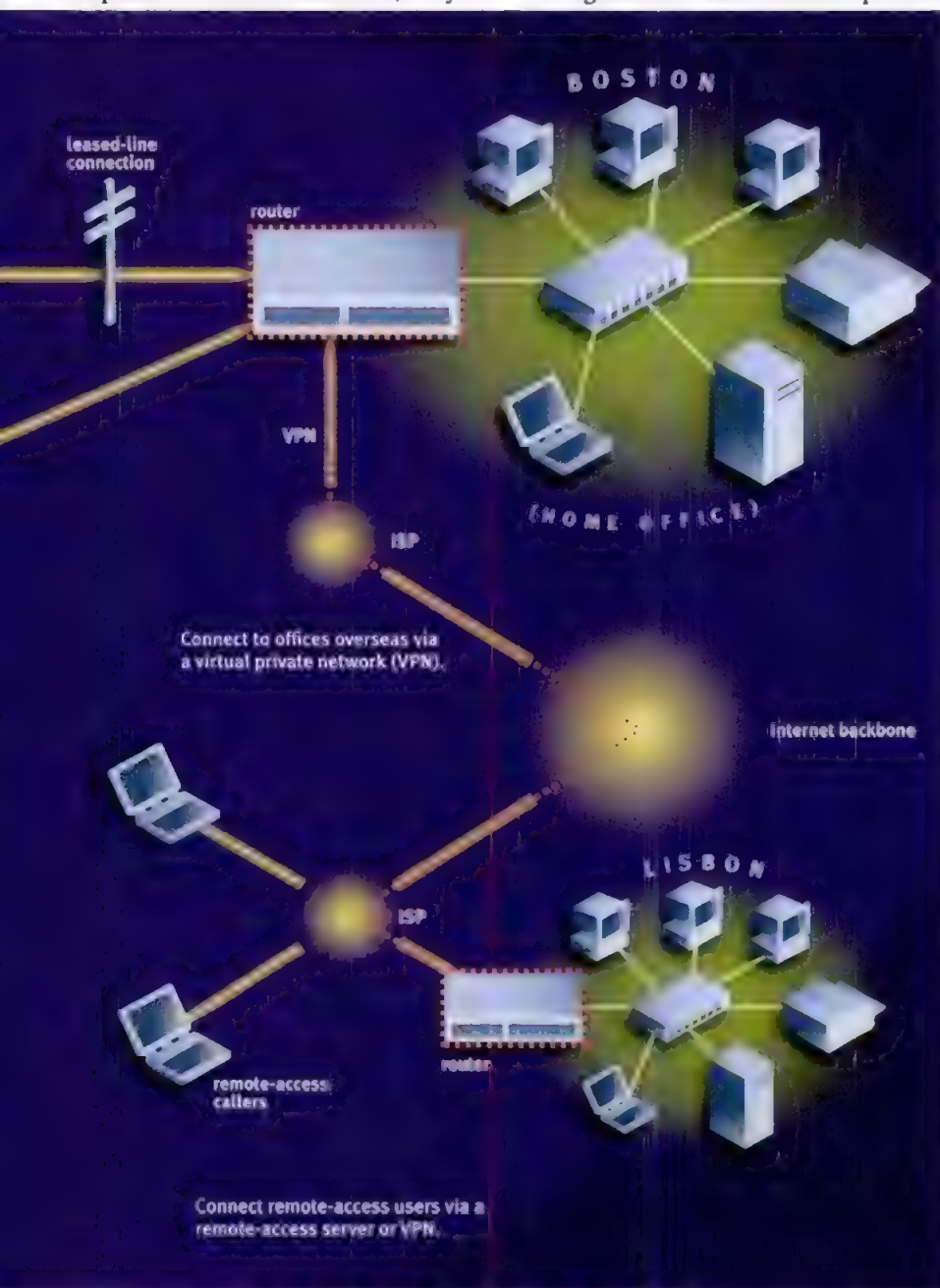
the most stable connection, the perfect enterprise connects to the Internet via a leased line to a local ISP. This approach also provides a fast Internet connection to your users. VPN software is available for a variety of hardware devices, such as a router, a NOS server, or as part of a firewall. Another option is to use a VPN service. Although standards such as IPsec ensure that VPNs can interoperate, you should use two similar devices or schemes to optimize performance.

A VPN can also be used to create an extranet connection between your LAN and external suppliers and shippers, for instance, or to provide remote access to the corporate network. Because VPNs are subject to unreliable Internet connections, you'll want to combine VPN remote access with dedicated remote-access servers in each corporate LAN location to ensure a constant connection.

Although network devices rarely fail, leased long-distance circuits and frame-relay services sometimes do. The perfect enterprise doesn't trust all its connections to one carrier or technology. Because redundancy provides reliability, you'd be wise to put alternate data routes in place: ISDN over your leased-line path, for example. Each of the services discussed here should guarantee a level of performance and availability, with failure to meet the terms resulting in a reduction in cost.

Connection strategies are only part of the story. The perfect enterprise has a network management system in place that can receive reports in the Simple Network Management Protocol (SNMP) from internal network devices and the vendors of contracted services. This lets you access graphical reports on the health of your entire network, perform real-time monitoring of devices, and receive alerts to potential problems. The network management system also provides Web access to each station and lets you monitor network devices remotely via a browser. (For more information, see "A Guide to Desktop Management," June 9, 1998.)

In addition to standard network services, the perfect enterprise may also provide newer services such as voice or fax over IP, which lets you make long-distance calls and transmit faxes over the Internet, avoiding related telephone charges.





Workgroup

Careful planning goes a long way in building a LAN that fits your budget and can keep pace with your growing business.

By Frank J. Derfler, Jr.

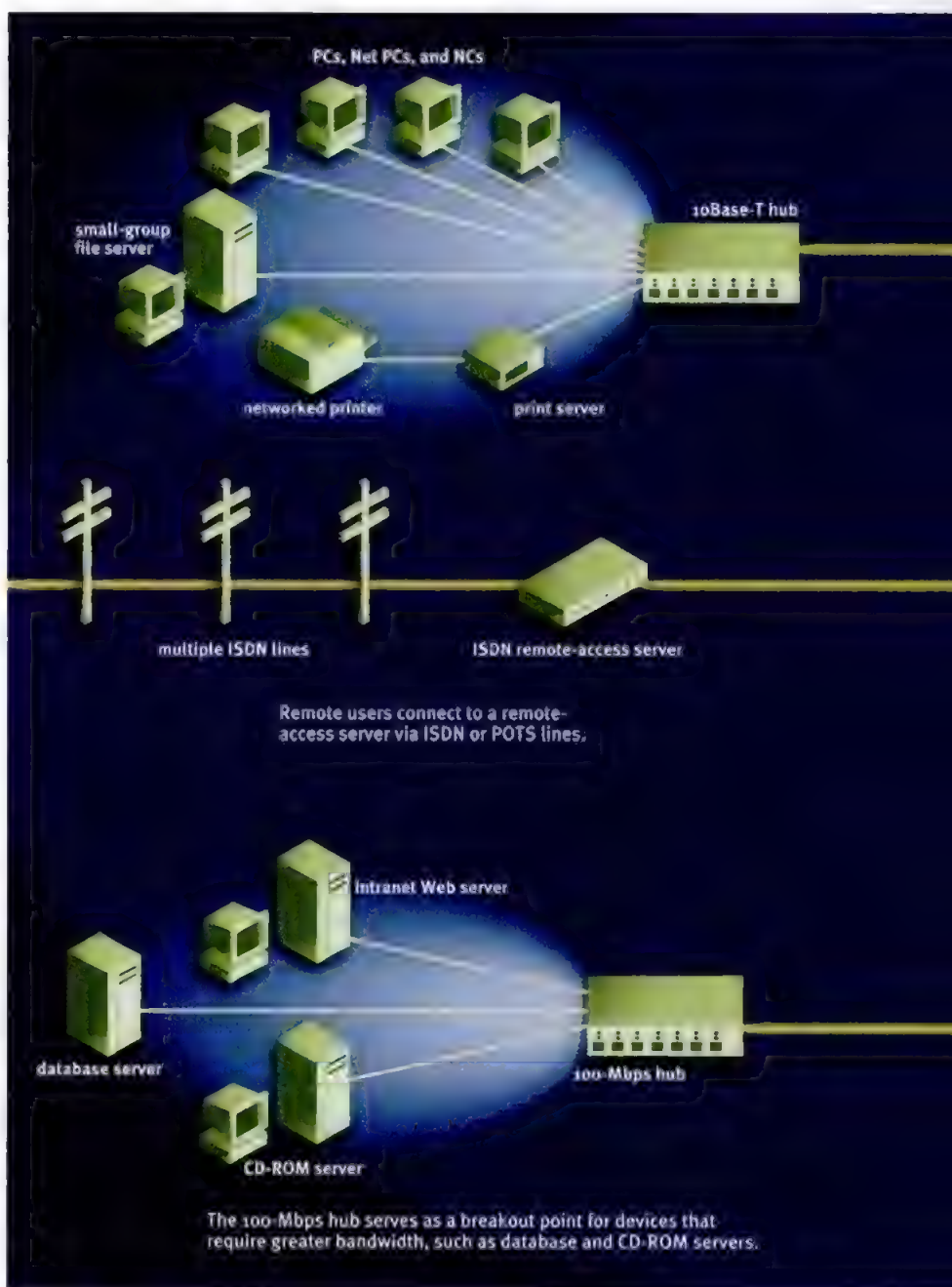
A small business needs to be penny-wise and still provide all the networking services needed to grow into a large business. The Perfect Workgroup uses inexpensive 10-Mbps hubs to control costs, implements switching to keep traffic localized, and provides secure and economical connections to the outside world.

In our scenario, 10Base-T hubs connect clusters of six to ten PCs, Net PCs, or NCs to a local printer. The hubs connect to PCs via 10/100-Mbps Ethernet cards. This approach lets you upgrade to a 100Base-T hub without buying new adapter cards.

The printer either attaches directly to a hub via a built-in network adapter or connects to a print server that's linked to the hub. Because the desktop PCs with typical applications don't require a connection greater than 10 Mbps, this configuration provides economy and convenience. Some workgroup LANs also include file servers to run specialized vertical applications or to store data that is unique to the smaller workgroup.

Each hub connects to a 10-Mbps switched port on a 10/100 switch that services the workgroup. The switch provides segmentation for network traffic, which keeps local traffic local and prevents problems from affecting the entire network. The switched ports connect to network-wide shared devices, such as company wide servers, the ISDN remote-access server, and Web, CD-ROM, and mail servers.

The perfect workgroup uses 10/100



switches that have 8 to 12 switched 10-Mbps ports and two 100-Mbps ports. It uses the 100-Mbps ports to connect a file server and a 100-Mbps hub. Connecting the file server directly to the switch and hub lets you achieve data rates of 200 Mbps by setting the ports to use full-duplexed Ethernet mode.

Because the file server is the central point of storage for valuable applications and files, it requires a backup device for safeguarding data. The perfect workgroup uses digital linear tape (DLT) for its high capacity, reliability, and ease of use. DLT

drives achieve 10-Mbps data rates for compressed files and 80-Mbps rates for uncompressed files, making them well suited for backing up server data.

The 100-Mbps hub serves as a break-out point for other devices that require fast connections, such as a SQL database server for specific business applications or a cluster of intranet Web, DNS, and other TCP/IP servers. A 100-Mbps hub can also provide a robust connection to any workgroup device with a large amount of data to move, such as a graphics workstation.

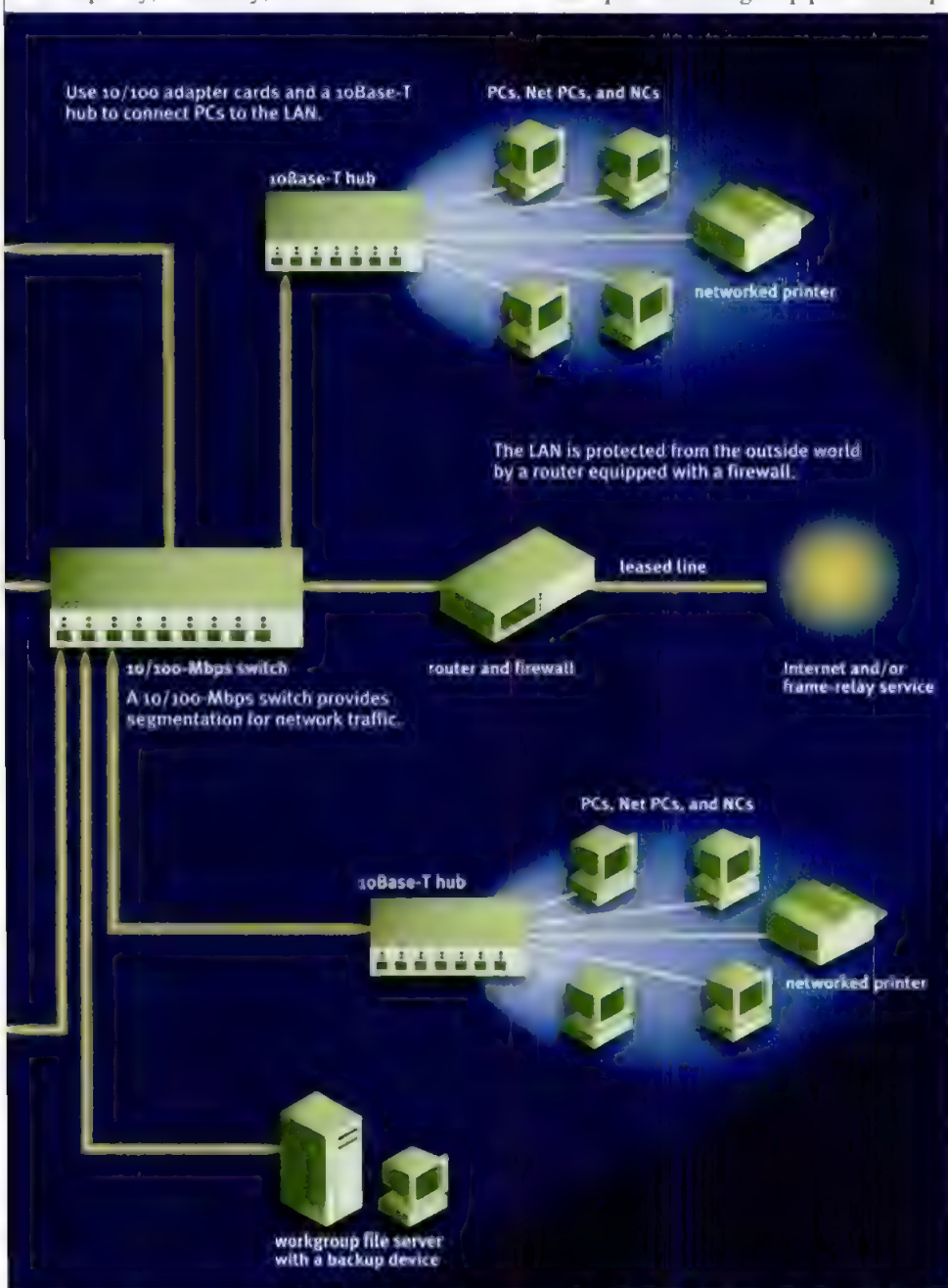
The perfect workgroup provides sup-

port for remote workers and traveling employees, connecting them to the remote-access server via ISDN and POTS (plain old telephone service) lines. It provides a fast Internet connection—ideally a T1 line connected to a local ISP. Businesses with remote offices or heavy traffic to another location should implement a direct leased line. Or, if they need to control costs, businesses should connect to a short leased line that links the LANs over a frame-relay service.

In addition to providing a fast Internet connection, the perfect workgroup protects the LAN from the outside world. Web traffic passes through a router equipped with a firewall. That router also includes a module for a frame-relay connection, for access to a corporate WAN.

In the coming years, digital subscriber line (DSL) services will begin replacing the leased-line portions of these connections. Virtual private networks (VPNs) across the Internet can be useful for some traffic (see "The Perfect Enterprise" for more on VPNs), and frame-relay services will grow in importance, because they offer flexibility and level cost. Even so, ISDN service from a local telephone company will continue to be the most economical method of providing connections to a remote-access server.

Even networks of only a few dozen nodes can benefit from some level of management. Most hub and switch vendors offer proprietary monitoring programs, even with their moderately priced products. The software will help track down troublesome links, let you monitor network traffic, and generate alerts to warn you when the network has reached high collision and utilization thresholds. In addition, the Perfect Workgroup includes PCs that support the Desktop Management Interface (DMI). This initiative has spawned a new generation of PCs that can report details of their internal configuration and operation to a relatively simple utility program. DMI software tracks the inventory of each network device and PC, and in the event of an impending component failure provides alerts before the system is affected. The software will also update desktop PCs across the network with the latest BIOS versions and with the latest drivers for components such as LAN adapters.





Intranet

Web technology makes it easier to share corporate information and communicate with the outside world.

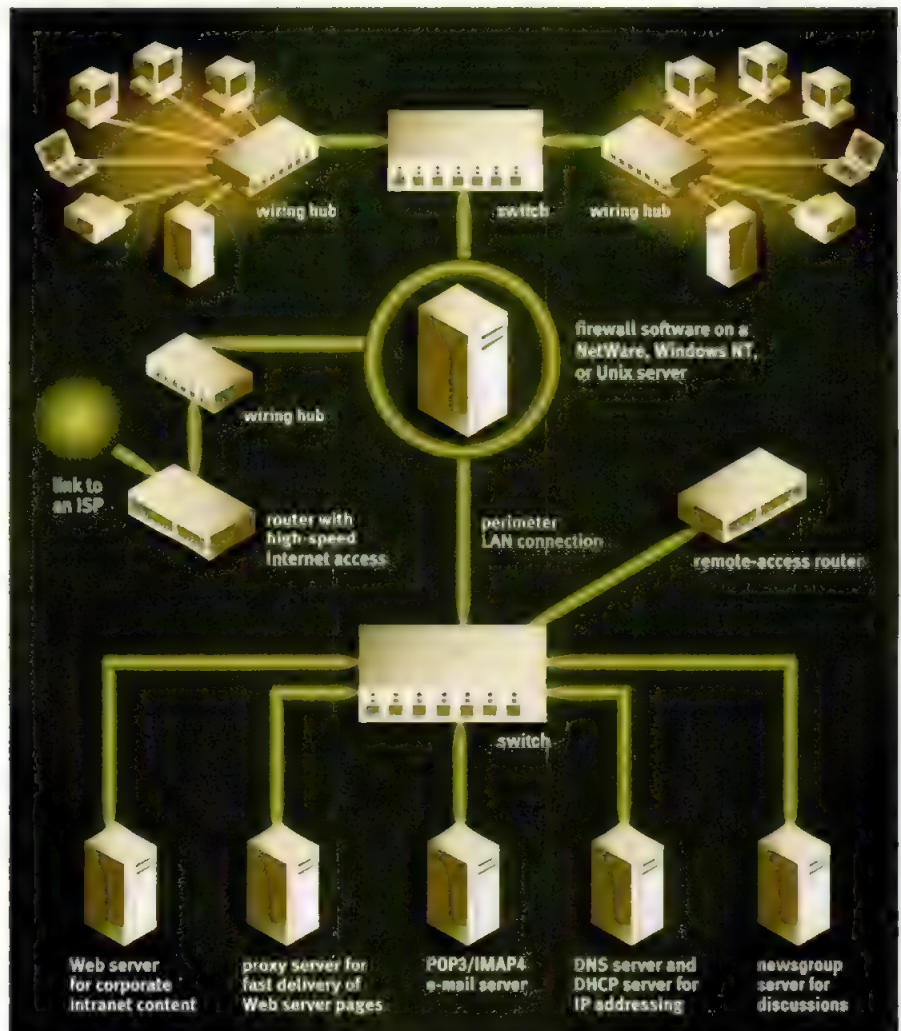
By Frank J. Derfler, Jr.

A corporate intranet can provide a host of services to a company. For instance, an intranet Web server is a handy and economical tool for publishing *write-once, read-many* documents within your organization and is accessible by anyone with a Web browser—even the Mac users in your art department. And if you want to grant server access to selected business partners and clients, you can create an extranet by letting those users connect to your intranet using a remote-access server or a leased line with a router.

TCP/IP-based e-mail and discussion software overcomes differences in operating systems and software preferences in client computers. But TCP/IP brings its own requirements, including a Domain Name Server (DNS) and an IP-addressing scheme such as the Dynamic Host Configuration Protocol (DHCP). DNS and DHCP have become such an integral part of network operation that many organizations have implemented redundant servers.

Because TCP/IP gives anyone on the Internet potential access to your servers, a crucial part of your intranet is the firewall. A firewall protects your servers by inspecting the destination and content of incoming network packets. The protection can be a piece of turnkey hardware, a function in a standalone router, or a capability included in software that is running on a special server. Firewall software is available for a wide variety of operating systems.

The Perfect Intranet is segmented into at least three components. The



Internet connection should enter the firewall on a dedicated LAN adapter, giving the firewall complete control over routing the incoming packets. This firewall server can host a second LAN adapter that lets users connect to other corporate LANs (creating an extranet). The firewall server together with the outside connections are collectively

referred to as the perimeter LAN.

A third LAN adapter links the firewall to the protected LAN. A network administrator can configure the firewall to deny access to multiple types of data, such as FTP file transfers. This ability serves to improve security and removes possible holes in the firewall that invaders would be able to exploit.



Home Network

With a fully wired home, you can access files, surf the Web, and monitor the front door from any room.

By Bill Howard

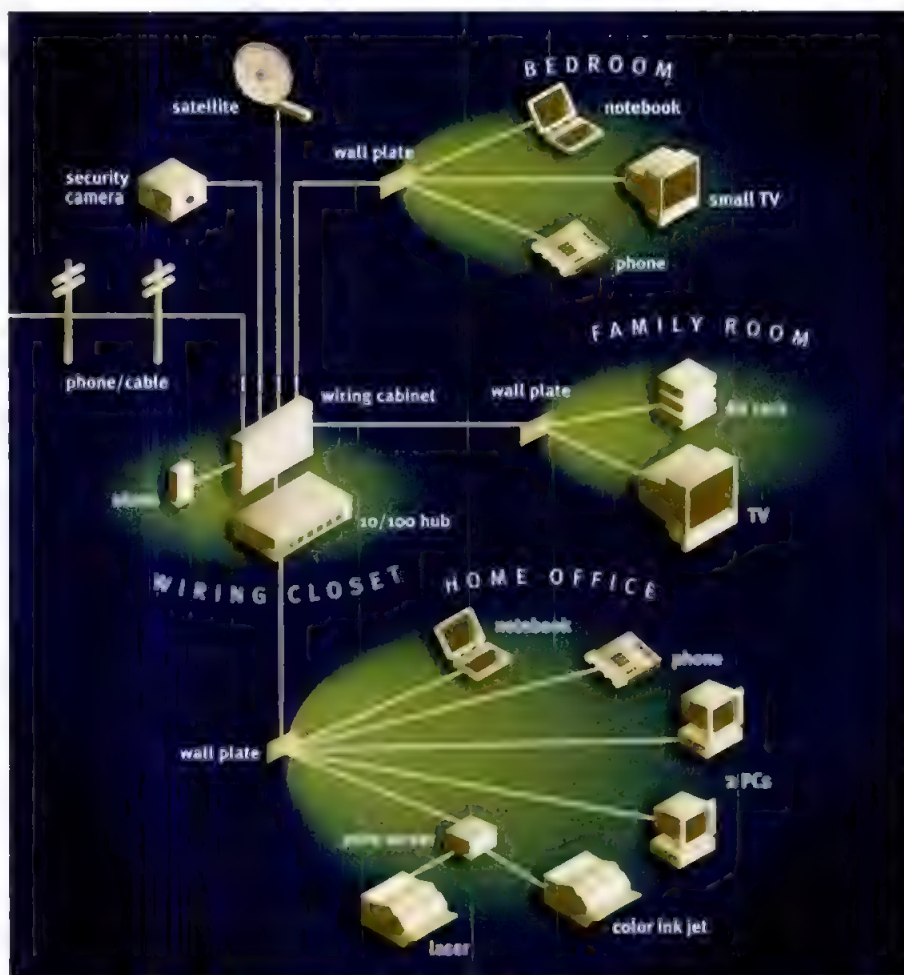
It's more than just a LAN plunked down in your home. The Perfect Home Network can connect business PCs and printers to your family PCs, entertainment devices, and telephone lines—even to a security system for monitoring the front door.

But because it is part of your home, the perfect home network is also a matter of personal taste. If wiring multiple rooms is overkill, impractical, or beyond your budget, keep all your equipment in a single room. Put network adapter cards in each PC and connect them all to a 10/100-Mbps fast Ethernet hub. Also consider a print server, a standalone box that has a network adapter and printer ports and lets you share multiple printers.

If you envision creating a home network that connects the computer in your child's bedroom to the PCs in the study, or if you want to use your laptop computer to access files on your desktop PC by plugging it into your kitchen's Ethernet connection, then you're ready to wire your home.

Every connected room should have two Category 5 unshielded twisted-pair (UTP) cables: one for the network and one for voice. The room should also have two high-quality RG6 coaxial cables for cable TV distribution and a data feed from a cable modem or satellite. Consider IEEE 1394 (FireWire) cabling, a high-speed transfer medium among PCs, external drives, and AV devices. Run the cables through your attic or basement, then drill holes through the ceiling or floor near the device.

All the wiring should run to a central



wiring closet, located either in the home office or a basement or garage. The closet should contain your network hub, a wiring cabinet to concentrate all the Category 5 and RG6 wiring, and security and telephone panels. Expect to spend \$1,000 to \$3,000 to wire a home as described, with \$500 to \$1,500 for the wiring cabinet and \$150 per room.

If you're willing to hold off for six months to a year, non-Ethernet net-

working solutions aimed at the home may be an enticing alternative. These products connect devices via wireless radio frequency (RF) signals, across AC power lines, or over existing analog phone lines. None will be as fast or reliable as an Ethernet LAN, but the price and flexibility might be worth the trade-off. Expect to pay \$100 to \$150 per connected network device for speeds between 100 Kbps and 1 Mbps.



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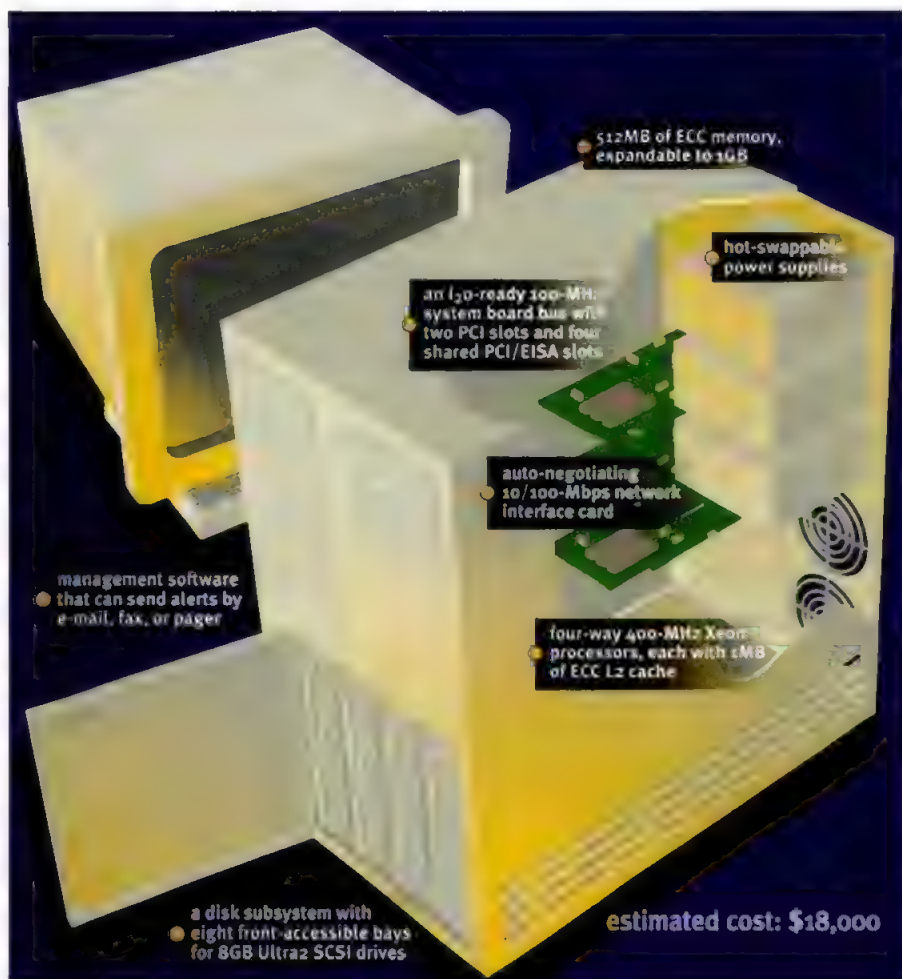
By Jeffrey Witt

In the Perfect Departmental Server, all good things come in pairs. That's because redundancy is key to ensuring that your server is always up and ready to deliver applications and documents to your network clients.

Four-way dual processing power gives a server the capacity to handle the CPU-intensive demands of applications such as e-mail and databases. Even when you're doing simple file or print sharing, OSs capable of symmetric multiprocessing (SMP) will balance the task load for increased performance. Error Correction Code (ECC) L2 cache enhances server reliability and data integrity, and caching data in RAM optimizes performance. DIMM memory modules permit easy upgrades and memory addition; ECC memory provides the utmost in reliability.

The perfect departmental server has two network adapter ports. This lets you segment client loads to ensure that the Ethernet connection doesn't become overloaded. The server also provides software that lets you bind both ports to create one aggregated pipe. You can add a second adapter either for additional bandwidth or for use as a backup.

The server bus runs at 100 MHz to speed access to system memory and the disk subsystem. The server houses multiple buses with plenty of PCI and combination shared PCI-EISA slots and accommodates hot-pluggable adapters. Although server bottlenecks have become less of a problem thanks to high-speed network adapters and PCI buses, the I/O subsystems that handle storage



and system communication continue to put a drag on performance. The server is also I2O capable, which means that it adds processing power to ease the burden of handling I/O interrupt tasks from the system CPU.

For the best data protection, the perfect departmental server's disk drives are redundant and hot-swappable. If cost is not an issue, consider adding RAID Level 5, for about \$1,000 to \$1,500 more. Fault

tolerance is essential, so the server should have hot-swappable power supplies with dual power cords, an uninterruptible power supply (UPS), and two redundant cooling fans.

The server should include management software capable of alerting you to system problems by a variety of methods as well as management agents for DMI and SNMP that let the server appear as part of a larger network management plan.

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Components

The right combination of adapters, hubs, and switches provides optimum performance and scalability while controlling costs.

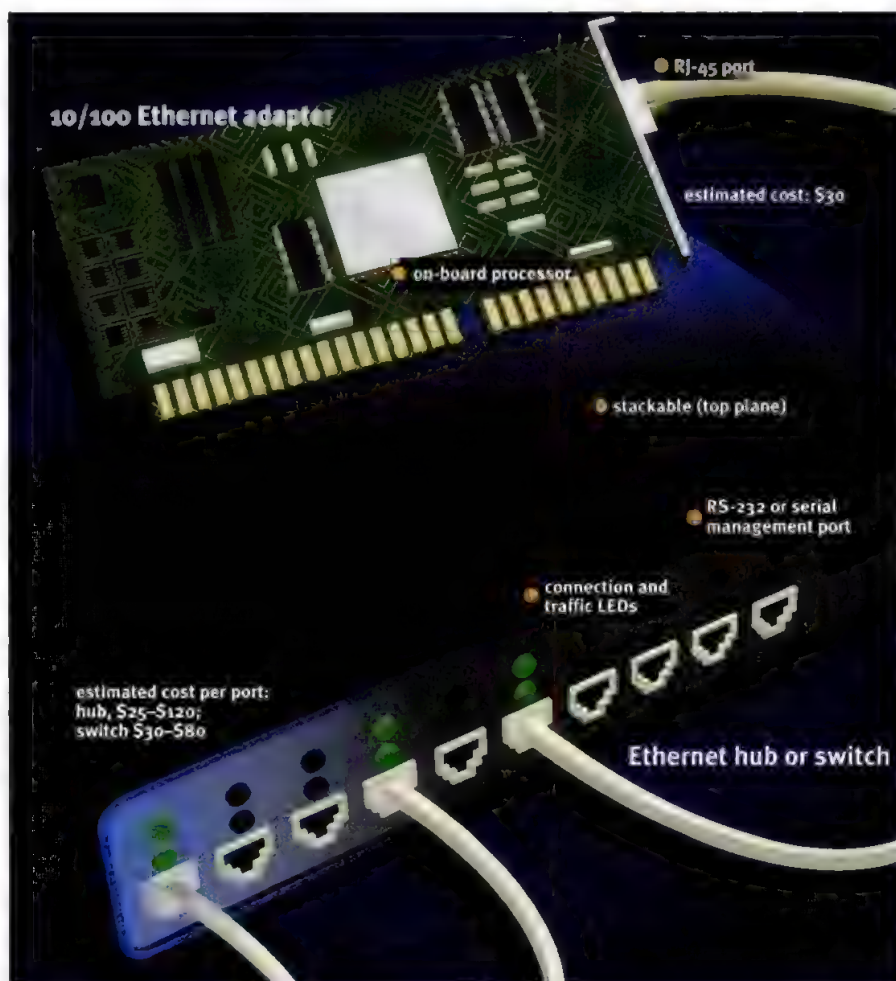
By Kristina DeNike

Components are the basic building blocks of the network. Choosing the right adapters, hubs, and switches optimizes overall performance and allows plenty of room to grow.

The Perfect Network Adapter is an auto-sensing, 10/100-Mbps Fast Ethernet adapter with N-WAY duplexing. It provides Plug and Play installation and includes SNMP, DMI, or other management agents. Software-based failover is included, and an on-board processor ensures that the client machine's CPU won't bog down while processing network tasks. The perfect server adapter has bus-mastering technology, which economizes CPU utilization by letting network requests go straight to the adapter and bypass the server's processor. It provides Wake-on-LAN technology so you can boot client PCs from the server.

Although a wiring hub is the least expensive way to connect your devices, the devices will need to compete for the same amount of bandwidth (usually around 10 Mbps); this impacts performance. For segmented networks or those running high-bandwidth applications, consider a switch. A switch gives each PC a dedicated connection via a virtual circuit, ensuring that it receives a set amount of bandwidth. A switch also maintains a list of media-access control (MAC) addresses—unique hardware-identification numbers generated by the network adapter—that help route traffic more efficiently.

Despite their differences, the perfect hub and switch share multiple features. Both have RJ-45 ports that auto-detect



the speed of traffic, and the switch auto-senses frame types. They are stackable, so you can add switches to the same network segment connected via a high-speed bus. Each includes a port for fast uplinks to a backbone network and offers options for asynchronous transfer mode (ATM), Fiber Distributed Data Interface (FDDI), and Gigabit Ethernet. The switch provides full duplexing through N-WAY technology.

Management software lets you configure the ports remotely. You should have access through a browser interface or a Windows console or via SNMP agents. The hub and switch include a serial PC connection, which lets you diagnose hardware problems. The software should also let you bind multiple ports to create one accelerated connection.

Price: Adapter, \$30; hub, \$25–\$120 per port; switch, \$30–\$80 per port.

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By Frank J. Derfler, Jr.

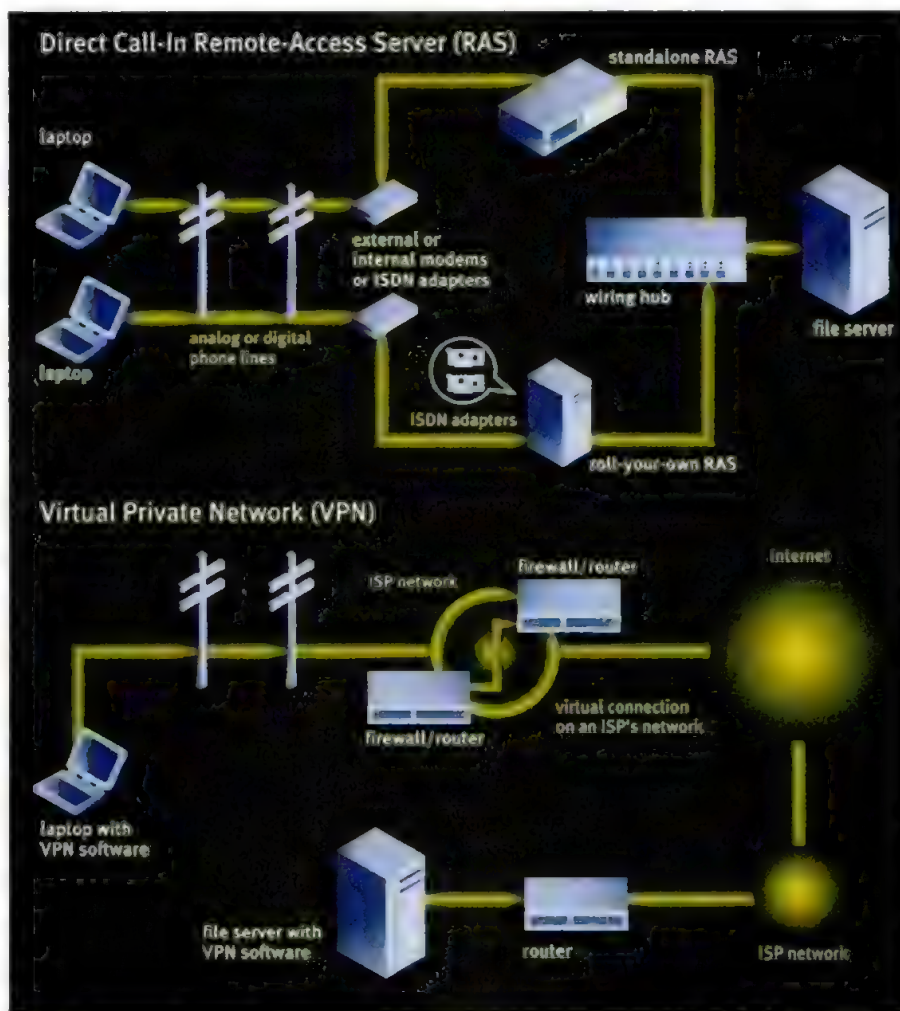
Corporate users outside the office are just as reliant on network services as those on the inside. Providing access to your mobile sales force, traveling executives, and even staffers who need to retrieve an important file at 2:00 A.M. requires a remote-access service (RAS). Two comparable methods are direct call-in, which connects users via dial-up ISDN or analog modems, and a virtual private network (VPN), which connects you over the Internet. In a nutshell, direct call-in provides superior reliability, and a VPN provides nimble scalability and potentially lower cost for long-distance connections.

If you go the direct call-in route, there's yet another choice to make: You can either purchase a standalone remote-access server or roll your own by installing multiport analog modems or ISDN adapters in a dedicated server and adding remote-access software, such as the Routing and Remote Access Service in the Windows NT Option Pack.

Both methods have their benefits. The standalone products offer reliability and simplicity; building your own solution requires some integration skills but saves you money in the short run. The perfect RAS uses ISDN lines to link to a telephone company's central office.

In either case, a remote-access server has a substantial initial price tag and plateaus of scalability. At some point down the road, you'll face a substantial upgrade cost: You will have used up the slots or ports in the server hardware, which will force you to buy new systems.

In contrast, a VPN solution provides a



smooth expansion path. You can set up your own tunneling servers or routers to encrypt and track packets sent over TCP/IP. Client computers run tunneling software, call any ISP for Internet access (avoiding long-distance charges), and then connect to your corporate servers. The data is encrypted, and the circuit provides good security. The only drawback is that the connection is subject to the

vagaries of the Internet. And as with a RAS, building a VPN involves an upfront hardware investment and on-site maintenance.

One way to avoid this is to subscribe to a VPN service, typically offered by ISPs. Depending on your connection needs, the calls may traverse the Internet, which subjects them to the same inconsistencies as on-site VPN connections. 



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We conduct this survey because we believe that service and support policies do more to distinguish good vendors from mediocre ones than system performance and price. Often, a vendor's service-and-support track record can be the tiebreaker in our Editors' Choice discussions. And we feel that knowing vendors' records can help you in your own buying decision, whether you're purchasing a PC for yourself or your company.

OVERALL TRENDS

The make-or-break question again this year is repair frequency—how often the unit needed repair in the preceding 12 months. In fact, only six desktop vendors and two notebook vendors are better than average. On the other hand, only one vendor per category ranks worse than average. This trend toward the average suggests that there is less difference with repair records than with satisfaction.

Our survey shows that users are generally satisfied with their systems. The averages for the three kinds of satisfaction scores are virtually the same as last year. Repair-frequency averages, however, are up. The desktop average is now 35 percent, compared with last year's 32 percent. The notebook average is now also 35 percent, up from last year's 30 percent. Note that responses to these questions indicate not just mechanical breakdowns but other service events as well, such as nonfunctioning network connections. What's important here is the relative standing of the vendors.

On the average, when a repair is necessary, our survey finds that desktop vendors can solve the problem over the phone 25 percent of the time. The vendor sends a new part 24 percent of the time, and the dispatch of a technician is necessary 28 per-

cent of the time. Desktops are sent out for repair 23 percent of the time.

Notebook results differ in two areas. On the average, when a repair is necessary, our survey finds that notebook vendors can solve the problem over the phone 23 percent of the time. The vendor sends a new part 25 percent of the time, and the dispatch of a technician is

necessary only 11 percent of the time. But notebooks are sent out for repair 50 percent of the time, which is attributable to their complexity as well as to their target market of power users and road warriors.

Our data shows another interesting trend: You may want to pick your vendor based on the manner in which you want your repairs handled. The dealer/VAR vendors such as HP, IBM, and Compaq are above average in their tendency to fix desktops on site (42 per-

cent, 35 percent, and 33 percent, respectively). The average of all vendors is 28 percent. Conversely, mail order/direct vendors Gateway, Quantex, and Micron have sent parts 49 percent, 45 percent, and 44 percent of the time, respectively, versus an average of 24 percent. This helps these vendors keep costs low, since sending a service technician on a call costs about \$200.

HOW WE SURVEYED

In January we mailed surveys to 17,000 *PC Magazine* subscribers asking them for their opinions on the quality of service and technical support they received from PC vendors over the past two years. Each subscriber was able to rate up to five systems used personally. We received a 50 percent response rate in March. The responses rate more than 16,317 desktops

from 25 vendors and 4,713 notebooks from 15 vendors.

This is how we arrived at the grades.

A—The vendor has better-than-average scores on all four key measures.

B—The vendor has a better-than-average score on at least one key measure and average scores on all the others.

C—The vendor has average scores on all four measures or (occasionally) a combination of better-than-average and worse-than-average scores.

D—The vendor is worse than average on at least one key measure and average on the others.

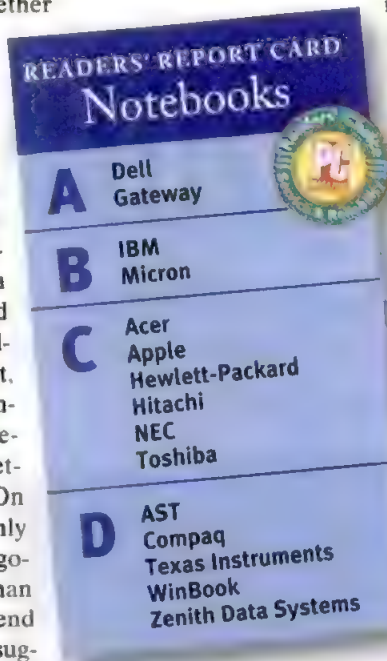
E—The vendor receives worse-than-average scores on all four key measures. No vendor receives an E this year.

Note that this survey covers machines used in the past two years. As a result, we include data from companies that are no longer in business or are no longer marketing PCs but whose PCs are still being used.

CompuAdd Computer Corp. is no longer in business, and CompuDyne and Tandy Corp. no longer manufacture PCs. We also include data regarding several computer companies that have changed status in the recent past. In June 1996, NEC Corp. and Packard Bell merged to form Packard Bell NEC. The new company markets three brands of PCs: NEC, Packard Bell, and Zenith Data Systems, and we rate these brands separately. Micron purchased ZEOS in 1996 and has since phased out the ZEOS name. And Acer acquired the Texas Instruments notebook division in February 1997.

DESKTOPS: THREE AT THE TOP

IBM receives an A for the sixth straight survey, and Dell earns an A for the third year in a row. What makes IBM and Dell the best, year after year? For IBM, it's preventing callers from enduring "multiple handoffs," and calling customers back to check on the success of proposed solutions. For Dell, the pioneer of the direct model, it's the ability to talk to customers directly from the beginning of the relationship, without the variability of good



Our Contributors: MARY E. BEHR is a staff editor and GORDON PLUTSKY is the research director at *PC Magazine*. SAMANTHA J. EDWARDS is a project manager in *PC Magazine*'s research department.



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DESKTOPS

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NOTEBOOKS

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GATEWAY

Whether for a large corporation or for an individual buyer, the importance of a vendor's service and support offerings cannot be understated. This year, *PC Magazine* subscribers award top honors to three desktop vendors and two notebook vendors.

In the desktop category, IBM gets an A for the sixth straight study and Dell for the third year in a row. Hewlett-Packard rejoins the top rank after last year's B and five previous A's. In the notebook category, Dell receives an A for the second year in a row. Gateway makes a dramatic leap from a C last year to an A this year.

To get a grade of A and thus win a Readers' Choice award, a vendor must be ranked better than average on all four of our key questions: satisfaction with reliability, satisfaction with repair experience, satisfaction with tech-

nical support, and the number of units that have needed to be repaired in the past 12 months (repair frequency). These scores determine the vendor's grades, from A to E. No vendor received an E this year, in either desktops or notebooks.

As with last year's findings, the question that proves to be a stumbling block for most vendors is the number of times a unit needed repair in the past year (repair frequency). Out of 25 desktop and 15 notebook vendors, only 6 desktop and 2 notebook vendors are ranked better than average on this question, and one vendor from each category is ranked below average. Average scores on this question keep Gateway, Micron, and Quantex from A's in the desktop category. IBM and Micron likewise miss A's in the notebook category.

As a trend, however, satisfaction with desktops and notebooks remains at the same high level it has been at for the past few years. Therefore, vendors receiving B's and C's are also providing capable service and support.

Our survey was mailed to 17,000 subscribers in January 1998. The survey was closed when we received a 50 percent response rate, which covered more than 21,000 individual machines. For more information on the statistical procedures used to tabulate the survey, please refer to the sidebar "How We Surveyed."

and bad dealers in between.

HP returns to the top after spending 1997 with a B. Previously, HP had five consecutive A's. HP has added about 10 percent more telephone technical-support personnel. The company also has several new customer-satisfaction programs; one, the Pavilion line's Customer Care Promise, ensures that calls will be answered within 3 minutes or the caller will receive a free 15-minute prepaid phone card.

A BUNCH OF B'S

Sony makes its debut with a B, with the best repair-frequency score in the study: Only 26 percent of its systems needed any repair during the past 12 months, compared with the desktop average of 35 percent. Additionally, Sony has the highest score for solving a problem over the phone (58 percent), thanks to a large facility in Florida.

Compaq receives its second B in a row. An average score for repair satisfaction keeps the company from the winners' circle. Notwithstanding, in the past year, Compaq has added 20 percent more call-support staff and a new call center in

Canada. Digital, subject of a pending acquisition by Compaq, also receives its second B in a row.

Direct vendors Gateway, Micron, and Quantex are all kept from A's by average scores for repair frequency. This is the fourth straight B for Gateway and Micron. Quantex debuted in last year's survey with a C and improves to a B this year.

MidWest Micro has also improved from a C last year to a B this year. Gateway, Micron, Quantex, and MidWest Micro get high scores for having knowledgeable tech-support staffs.

A SEA OF C'S

With eight vendors discussed here, C is the most common grade. Apple drops to a C after six B's. Toshiba, which debuted with a B last year, drops down to a C as a result of its satisfaction-with-reliability score falling to average. NEC gets a C for the second straight year.

There were also some gains in this category. DTK, Everex, and Unisys, all D's last year, improve to average scores on all counts this year. The other C's are the defunct CompuAdd and ZEOS brands.

SEVEN D'S

Acer and AST both receive their second straight D's. Acer is below average for repair frequency; AST is below average for satisfaction with reliability.

Even after making a large investment in a Utah technical-support facility, Packard Bell still gets a D. In fact, for the second year in a row, Packard Bell is below average on all three satisfaction measures. Only an average score for repair frequency keeps Packard Bell from an E. Packard Bell also gets the worst score for customers "getting the run-around" from the company's technical-support staff, twice as bad as the survey average.

Other D earners AT&T GIS, CompuDyne, Tandy, and ZDS no longer manufacture PCs.

NOTEBOOK A'S

Gateway moves all the way up from a C to join fellow direct vendor and repeat winner Dell. Gateway was last graded in our January 1995 study. Not surprisingly, both vendors receive better-than-average scores for the buy-again question.

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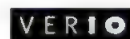
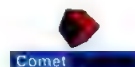
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Readers Rate PC Vendors

Four questions contribute to the vendors' grades: the number of units needing repair over the past 12 months and the three measures of satisfaction. The question about buying again is included to give additional weight into PC Magazine subscribers' perceptions of vendors.

- Significantly better than average
- Average
- Significantly worse than average

Units needing repair
over the past 12 months

Satisfaction with:
Reliability

Repair

Tech support

Buy again?

DESKTOP VENDORS (NUMBER OF RESPONSES)

Acer (419)	● 41%	○ 7.6	○ 7.4	○ 6.9	○ 6.0
Apple (431)	● 29%	● 7.4	○ 7.3	○ 6.9	● 5.2
AST (408)	○ 35%	● 7.4	○ 7.1	● 6.6	● 5.3
AT&T GIS (99)	○ 34%	● 7.0	● 6.6	○ 6.5	● 3.9
Compaq (1,893)	● 32%	● 8.1	○ 7.4	● 7.2	● 6.9
CompuAdd (52)	○ 40%	○ 7.5	○ 7.6	○ 6.9	● 3.9
CompuDyne (61)	○ 38%	● 6.9	● 6.1	● 5.4	● 4.3
Dell (1,956)	● 28%	● 8.8	● 8.5	● 8.3	● 8.6
Digital (246)	○ 37%	● 8.0	○ 7.7	● 7.5	○ 6.0
DTK (70)	○ 39%	○ 7.7	○ 7.3	○ 6.5	○ 5.4
Everex (56)	○ 38%	○ 7.4	○ 7.1	○ 7.1	● 4.5
Gateway (2,414)	○ 34%	● 8.5	● 8.2	● 8.0	● 8.1
Hewlett-Packard (875)	● 31%	● 8.2	● 7.9	● 7.7	● 7.4
IBM (1,532)	● 31%	● 8.1	● 7.6	● 7.6	● 6.9
Micron (812)	○ 35%	● 8.6	● 8.2	● 8.2	● 8.2
MidWest Micro (58)	○ 45%	○ 7.9	● 8.1	● 7.8	○ 6.6
NEC (290)	○ 33%	○ 7.9	○ 7.4	○ 7.1	● 6.5
Packard Bell (984)	○ 38%	● 6.8	● 6.1	● 5.6	● 4.8
Quantex (151)	○ 37%	● 8.6	● 8.3	● 7.9	● 8.0
Sony (100)	● 26%	● 8.5	○ 8.0	● 7.9	● 7.9
Tandy (75)	○ 35%	● 6.8	● 6.2	● 5.7	● 3.9
Toshiba (293)	○ 36%	○ 7.9	○ 7.2	○ 7.2	● 6.9
Unisys (58)	○ 28%	○ 7.4	○ 7.0	○ 6.9	● 4.6
Zenith Data Systems (124)	○ 42%	● 7.1	● 6.3	● 6.0	● 3.8
ZEOS (214)	○ 30%	○ 7.9	○ 7.4	○ 6.7	● 4.8
AVERAGE	35%	7.8	7.4	7.4	5.9

NOTEBOOK VENDORS (NUMBER OF RESPONSES)

Acer (55)	○ 36%	○ 7.9	○ 7.3	○ 7.4	○ 6.5
Apple (96)	○ 36%	○ 8.0	○ 7.5	○ 7.5	○ 6.2
AST (101)	○ 33%	● 7.3	● 6.5	● 6.5	● 5.7
Compaq (621)	○ 37%	● 7.8	○ 7.2	○ 7.4	○ 7.0
Dell (397)	● 29%	● 8.7	● 8.2	● 8.4	● 8.3
Gateway (249)	● 28%	● 8.6	○ 8.1	● 8.4	● 8.1
Hewlett-Packard (100)	○ 32%	○ 8.4	○ 7.6	○ 7.9	○ 7.5
Hitachi (55)	○ 29%	○ 7.8	○ 6.8	○ 7.5	○ 7.2
IBM (741)	○ 33%	● 8.4	● 8.0	● 7.9	● 8.1
Micron (145)	○ 38%	● 8.9	● 8.5	● 8.6	● 8.6
NEC (164)	○ 34%	○ 8.1	○ 7.6	○ 7.5	○ 7.0
Texas Instruments (127)	● 47%	● 7.3	○ 6.8	● 6.5	● 5.2
Toshiba (921)	○ 34%	● 8.2	○ 7.4	● 7.2	● 7.7
WinBook (109)	● 52%	○ 7.8	○ 6.9	○ 7.3	○ 7.0
Zenith Data Systems (58)	○ 24%	● 7.0	○ 6.4	● 6.3	● 4.6
AVERAGE	35%	8.0	7.4	7.5	7.0

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Vendor Grades Past and Present

This year, PC Magazine subscribers rated 25 desktop vendors and 15 notebook vendors. Sony makes a first-time appearance in the desktop category with a grade of B, and Hitachi debuts in the notebook field with a C.

	7/98	7/97	7/96	7/95	1/95	7/94	1/94	7/93
DESKTOP VENDORS								
Acer	D	D	C	C	B	C	D	D
Apple	C	B	B	B	B	B	B	C
AST	D	D	C	B	C	C	B	B
AT&T GIS	D	C	C*	D*	B*	E	E	E
Compaq	B	B	A	A	A	A	B	A
CompuAdd	C	B	C	D	B	C	C	A
CompuDyne	D	E	D	C	C	C	C	C
Dell	A	A	A	B	A	A	A	A
Digital	B	B	B	A	A	A	B	B
DTK	C	D	C	C	C	C	D	C
Everex	C	D	D	D	D	D	C	C
Gateway	B	B	B	B	A	A	A	A
Hewlett-Packard	A	B	A	A	A	A	A	B
IBM	A	A	A	A	A	A	B	B
Micron	B	B	B	B	A	A	B	N/A
MidWest Micro	B	C	D	B	C	N/A	N/A	N/A
NEC	C	C	B	B	C	C	D	B
Packard Bell	D	D	D	C	E	E	E	E
Quantex	B	C	N/A	N/A	N/A	N/A	N/A	N/A
Sony	B	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Tandy	D	D	C	D	E	E	E	E
Toshiba	C	B	N/A	N/A	N/A	N/A	N/A	N/A
Unisys	C	D	D	D	D	C	C	D
Zenith Data Systems	D	D	D	D	E	E	E	E
ZEOS	C	B	C	C	A	A	A	A
NOTEBOOK VENDORS								
Acer	C	D	C	N/A	C	B	N/A	N/A
Apple	C	C	B	C	A	A	A	B
AST	D	D	D	D	D	D	D	B
Compaq	D	C	A	A	A	A	A	A
Dell	A	A	B	C	D	C	B	A
Gateway	A	C	B	B	A	B	A	C
Hewlett-Packard	C	B	B	B	A	B	N/A	N/A
Hitachi	C	N/A	N/A	N/A	N/A	N/A	N/A	N/A
IBM	B	B	B	B	A	A	B	A
Micron	B	B	N/A	N/A	N/A	N/A	N/A	N/A
NEC	C	B	B	B	B	B	D	D
Texas Instruments	D	D	D	C	A	A	C	C
Toshiba	C	B	A	A	B	B	B	A
WinBook	D	C	C	N/A	N/A	N/A	N/A	N/A
Zenith Data Systems	D	D	D	D	E	E	E	E

* AT&T GIS and NCR were one company at the time of these surveys. N/A—Not applicable: This vendor was not represented in our published survey results.

Feelin' Fast, Punk?



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CTX

Repairs and Technical Support

- Significantly better than average
- Average
- Significantly worse than average

REPAIR EXPERIENCE (among those needing repairs)

TECH-SUPPORT EXPERIENCE (among those using technical support)

	Time on hold (minutes)	Problem solved over the phone	Sent new part	Fixed on-site	PC was sent out for repair	Got a new PC	Got a run-around	Tech was knowledgeable	Tech tried everything to help	Prompt resolution	More than one call to resolve
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DESKTOP PC VENDORS

Acer	○	13.2	24%	20%	22%	29%	3%	18%	35%	29%	26%	29%
Apple	○	14.3	18%	17%	31%	31%	1%	22%	35%	31%	24%	31%
AST	○	16.8	20%	20%	29%	25%	2%	17%	35%	31%	29%	29%
AT&T GIS	○	15.7	18%	15%	29%	35%	3%	29%	29%	25%	29%	42%
Compaq	○	12.1	25%	25%	33%	23%	4%	17%	37%	30%	30%	34%
CompuAdd	○	26.7	14%	14%	14%	33%	N/A	N/A	22%	N/A	22%	33%
CompuDyne	○	12.2	13%	17%	35%	26%	N/A	26%	26%	5%	26%	42%
Dell	○	11.2	33%	30%	34%	7%	3%	10%	54%	43%	49%	20%
Digital	○	9.2	21%	16%	51%	19%	6%	13%	44%	37%	40%	29%
DTK	○	13.8	15%	37%	33%	26%	N/A	19%	33%	19%	29%	48%
Everex	○	9.0	24%	5%	24%	24%	N/A	18%	55%	9%	45%	18%
Gateway	○	10.8	40%	49%	14%	9%	3%	10%	54%	48%	45%	28%
Hewlett-Packard	○	10.5	22%	23%	42%	9%	4%	11%	42%	35%	37%	29%
IBM	○	9.9	24%	23%	35%	24%	3%	15%	41%	33%	36%	28%
Micron	○	11.0	43%	44%	18%	9%	2%	9%	56%	47%	43%	25%
MidWest Micro	○	9.1	38%	27%	23%	15%	N/A	8%	60%	52%	28%	20%
NEC	○	11.9	29%	16%	35%	22%	N/A	20%	38%	30%	19%	33%
Packard Bell	○	19.0	28%	15%	19%	27%	2%	32%	31%	26%	24%	41%
Quantex	○	14.0	38%	45%	11%	13%	N/A	9%	57%	59%	49%	26%
Sony	○	10.1	58%	31%	15%	12%	4%	13%	53%	53%	56%	24%
Tandy	○	8.1	8%	23%	15%	42%	N/A	6%	29%	24%	12%	24%
Toshiba	○	15.1	25%	23%	13%	38%	5%	19%	41%	25%	25%	30%
Unisys	○	13.8	13%	19%	69%	25%	6%	7%	36%	36%	36%	29%
Zenith Data Systems	○	14.4	8%	17%	50%	19%	2%	26%	23%	20%	14%	31%
ZEOS	○	15.3	26%	29%	8%	22%	2%	14%	33%	41%	33%	30%
AVERAGE		13.1	25%	24%	28%	23%	3%	16%	40%	33%	32%	30%

NOTEBOOK PC VENDORS

Acer	○	7.4	20%	35%	5%	50%	5%	5%	55%	40%	30%	45%
Apple	○	15.6	9%	26%	6%	66%	3%	16%	55%	45%	35%	29%
AST	○	13.1	18%	21%	9%	45%	3%	26%	42%	23%	23%	39%
Compaq	○	11.4	20%	26%	22%	41%	7%	14%	47%	33%	40%	30%
Dell	○	10.3	50%	37%	17%	23%	10%	7%	65%	44%	56%	16%
Gateway	○	10.1	32%	45%	4%	33%	14%	9%	49%	53%	49%	21%
Hewlett-Packard	○	10.4	9%	22%	9%	53%	13%	9%	47%	25%	38%	31%
Hitachi	○	8.2	44%	6%	N/A	56%	N/A	21%	58%	47%	42%	21%
IBM	○	10.3	20%	21%	15%	50%	4%	15%	49%	38%	39%	26%
Micron	○	8.8	36%	42%	4%	40%	5%	1%	72%	70%	60%	15%
NEC	○	9.3	16%	18%	13%	55%	9%	12%	48%	37%	33%	25%
Texas Instruments	○	13.3	17%	17%	3%	62%	2%	27%	35%	29%	20%	31%
Toshiba	○	13.7	20%	17%	15%	54%	6%	19%	42%	33%	34%	33%
WinBook	○	9.2	16%	23%	N/A	74%	4%	22%	46%	43%	31%	26%
Zenith Data Systems	○	16.8	21%	21%	21%	43%	7%	42%	33%	33%	25%	25%
AVERAGE		11.2	23%	25%	11%	50%	7%	16%	50%	40%	37%	28%

N/A—Not applicable: There were no responses for this question.

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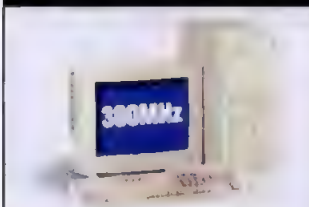
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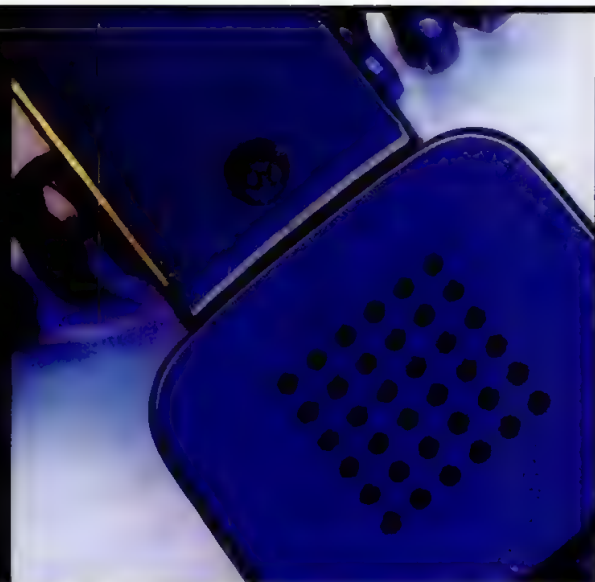
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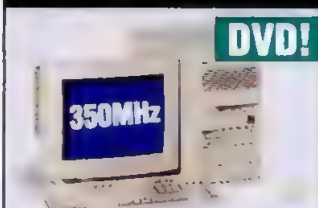


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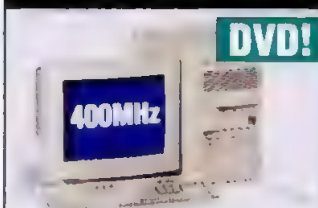


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- 8.4GB Ultra DMA Hard Drive
- Creative Labs 2X-DVD
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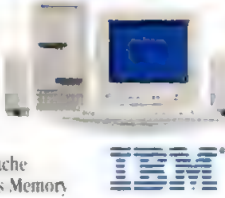
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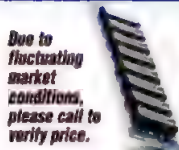
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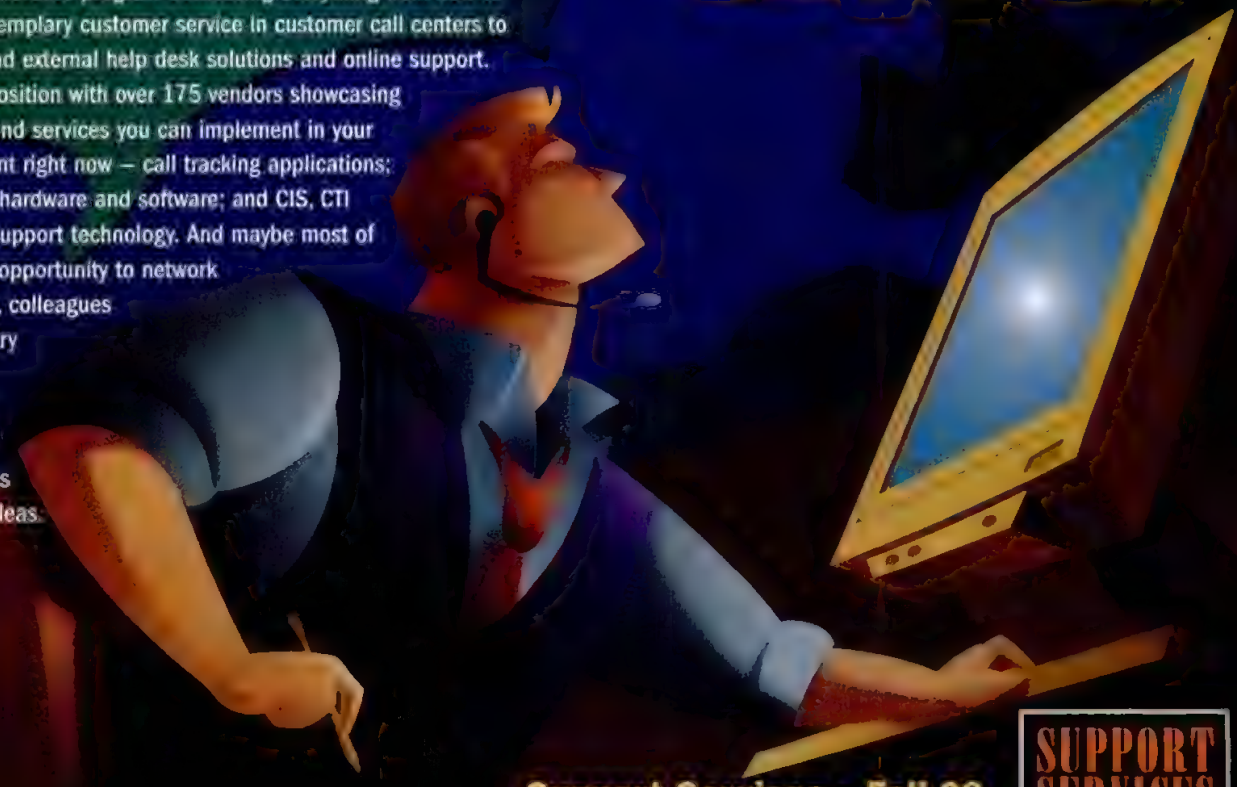
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How We Surveyed

Back in January 1998 we mailed 17,000 questionnaires to a randomly selected sample of *PC Magazine* subscribers. The survey was closed for tabulation on March 16, when we had achieved a response rate of 50 percent. Willard and Shullman, a research firm based in Greenwich, Connecticut, tabulated the survey.

The survey covered desktop PCs, notebooks, printers, and software applications. The printer and software results can be found later in this issue.

Each subscriber was asked to rate up to five desktop and five notebook PCs and five printers used in the past two years. Subscribers were asked to rate their satisfaction, using a scale from 1 ("not at all satisfied") to 10 ("very satisfied"), for overall reliability, repair experience, and techni-

cal support. They also indicated the number of times their PCs needed to be repaired in the past 12 months. Respondents also indicated which software applications they had installed and used most often in each of five categories. They rated their overall satisfaction, their satisfaction with technical support, and their satisfaction with a number of specific types of technical support.

Only those vendors for which we received 50 or more responses—the minimum number necessary to produce statistically reliable results—were included in the final tabulations. On each survey question, the individual readers' ratings for each manufacturer are averaged to make a score for that vendor. Each manufacturer's score is then compared with the others using a statistical test known as a *t-test*.

A *t-test* measures each individual manufacturer's score on each measure against the overall average for all manufacturers and determines whether the scores are significantly different at a 95 percent confidence level. *T-tests* take into account different variables, including the number of responses each manufacturer received, the amount of variation among those ratings, and the ratings themselves. These components determine the *confidence interval* for each score, the range into which we are 95 percent certain that the score belongs. When this range is entirely above or below the overall average, then we can say that the score is *significantly different* from the overall average.

This leads us to an important point: When we are looking at the difference between two groups of responses, we have to judge the difference between their means relative to the spread or variability of the individual ratings. Two vendors may have identical scores, but their ranges (or the variability among each vendor's individual ratings) will determine whether those scores are significantly different from the overall average.—Samantha J. Edwards

Compaq (1,893)	7.2
CompuAdd (52)	6.9
CompuDyne (61)	5.4
Dell (1,956)	8.3
Digital (246)	7.5
DTK (70)	6.5
Everex (56)	7.1
Gateway (2,414)	8.0
Hewlett-Packard (875)	7.7
IBM (1,532)	7.6
Micron (812)	8.2
MidWest Micro (58)	7.8
NEC (290)	7.1
Packard Bell (984)	5.6
Quantex (151)	7.9
Sony (100)	7.9
Tandy (75)	5.7
Toshiba (293)	7.2

As the graphic shows, though two vendors may receive the same numerical score, when *t-tested* against the average, one may emerge as significantly better or worse than average while the other does not

JUST TWO B'S

IBM receives a B for its notebook offerings. This is the fourth straight notebook B for IBM; an average score for repair frequency keeps it from an A. Last year, direct vendor Micron had a strong debut with a B. The company receives a B again this year, missing an A by having an average repair-frequency score. But IBM and Micron are both ranked above average for a customer's likelihood to buy again.

SIX C'S

As with desktops, C is the most common score. HP, NEC, and Toshiba all drop from last year's B to C this year. Market sales leader Toshiba is the only notebook vendor to get a worse-than-average score

for time on hold, which suggests room for improvement in its tech-support department. Relative newcomer Hitachi appears in this study for the first time; the company receives a C. Apple gets its second consecutive C. Acer moves up from last year's D, despite acquiring the Texas Instruments Mobile Computing Division. That acquisition more than doubled Acer's service liability, as it now supports older Texas Instruments notebook models.

FIVE D'S

Compaq, number two in notebook sales, falls to a D from a C last year and six previous A's because of the company's worse-than-average score for customer

satisfaction with the vendor's reliability.

Direct vendor WinBook receives a D this year after two straight C's by having the worst repair-frequency score in the notebook study. Subscribers say 52 percent of their systems needed repairs in the past 12 months. The company is currently constructing a new facility that will house all service and support operations.

AST receives a D for the seventh consecutive survey. Acer subsidiary Texas Instruments gets its third D in a row, and defunct ZDS gets its fourth D in a row.

Summaries of the Service and Reliability scores will appear in our comparative reviews of PCs and notebooks over the next year, to assist you with your buying decisions. **PC**

4PEAT

ARE WE TALKING DYNASTY HERE?



PC COMPUTING'S TORTURE TEST WINNER 1995: DELL' LATITUDE' XP 4100CX



PC COMPUTING'S TORTURE TEST WINNER 1996: DELL LATITUDE XPi P120ST



PC COMPUTING'S TORTURE TEST SURVIVOR 1997: DELL LATITUDE XPi P150ST



PC COMPUTING'S TORTURE TEST WINNER 1998: DELL LATITUDE CP M233ST

Illustration represents an exaggeration of actual test conditions. Product testing described or depicted is not recommended or warranted by the manufacturer. Limited warranty does not cover product damage resulting from accidents, abuse or misuse. Amount of coffee spilled is 1oz.

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- Modular 3.5" Floppy Disk Drive
- 128-bit Graphics Accelerator
- Stereo Speakers with 3D Surround Sound
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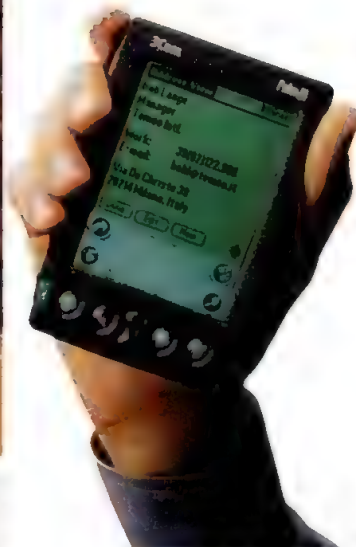
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Readers Rate Printer Service & Reliability

Print quality and speed are only part of the story,
especially if you rely on your printer day in and day out.

By Samantha J. Edwards and Josh Levy

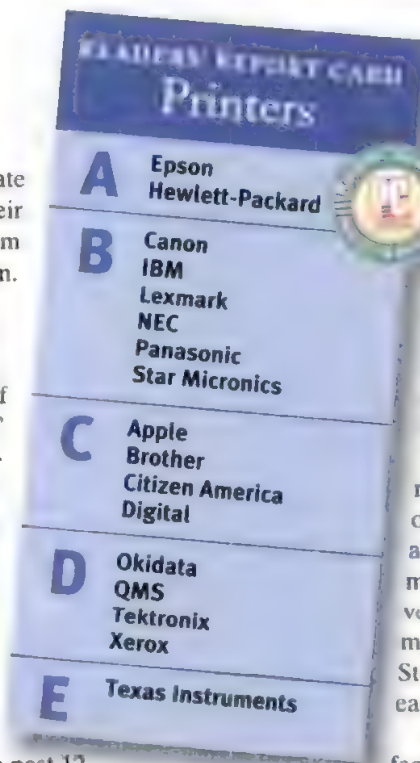
Comparison shopping for a new printer can be a tough job. Poring over features, speeds, and prices and then matching them to your specific needs takes a long time—and when you've finally narrowed down the choices, you're still not ready to buy until you hear how other customers feel about the printer you're considering. Is it reliable? Does the company have a dependable and knowledgeable service and support staff? Are users likely to buy a printer from the same manufacturer again?

For seven studies now, *PC Magazine* has surveyed its readers and asked them to rate the printers they've used in terms of overall satisfaction with reliability, repair, and technical support. We've also asked them how many times in the past 12 months their printers have needed repair. Based on these four measures, we've constructed a Readers' Report Card that assigns a grade to every major printer vendor. We've also

asked readers to indicate the likelihood of their buying a printer from the same vendor again.

HOW OUR READERS SEE THINGS

To merit a grade of A on the Readers' Report Card, a vendor has to receive better-than-average scores on all four of the key measures—satisfaction with reliability, repair experience, and technical support, and whether the printer needed service in the past 12 months. This year, as in previous years, only two vendors are able to meet this high standard and earn an A: Epson and Hewlett-Packard. Among readers who



READERS' REPORT CARD Printers	
A	Epson Hewlett-Packard
B	Canon IBM Lexmark NEC Panasonic Star Micronics
C	Apple Brother Citizen America Digital
D	Okidata QMS Tektronix Xerox
E	Texas Instruments

have used a Hewlett-Packard printer during the last two years, 75 percent rate the idea of purchasing another HP product "extremely likely." Epson's buy-again rating is nearly as impressive, at 60 percent.

The grade of B, which represents a combination of better-than-average and average scores on the four measures, goes to six of the vendors: Canon, IBM, Lexmark, NEC, Panasonic, and Star Micronics. All six also earned a B last year.

Canon's score for satisfaction with technical support has improved to better than average this year, and our readers' satisfaction with overall reliability and with repair experience remains average. NEC, which has

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Readers Rate Printer Vendors

- Significantly better than average
- Average
- Significantly worse than average

Units needing repair
over the past 12 months

Satisfaction with:
Reliability

Repair

Tech support

Buy again?

VENDOR (NUMBER OF RESPONSES)

VENDOR (NUMBER OF RESPONSES)	Units needing repair over the past 12 months	Satisfaction with: Reliability	Repair	Tech support	Buy again?
Apple (207)	○ 21%	○ 8.4	○ 7.9	○ 7.6	○ 6.3
Brother (195)	○ 25%	○ 8.2	○ 7.1	○ 7.2	○ 7.2
Canon (1,419)	○ 18%	○ 8.3	○ 7.8	○ 7.9	○ 7.8
Citizen America (63)	○ 17%	○ 7.9	○ 7.9	○ 7.0	○ 5.9
Digital (86)	○ 19%	○ 8.0	○ 7.5	○ 7.8	○ 6.2
Epson (1,031)	○ 13%	○ 6.7	○ 6.2	○ 6.1	○ 8.3
Hewlett-Packard (8,273)	○ 15%	○ 9.1	○ 8.7	○ 8.6	○ 9.2
IBM (332)	○ 12%	○ 8.4	○ 8.2	○ 8.1	○ 7.0
Lexmark (537)	○ 22%	○ 8.4	○ 7.9	○ 8.0	○ 7.7
NEC (101)	○ 17%	○ 8.5	○ 7.3	○ 7.7	○ 7.0
Okidata (434)	○ 27%	○ 8.3	○ 7.6	○ 7.6	○ 7.0
Panasonic (589)	○ 14%	○ 8.4	○ 7.9	○ 7.5	○ 6.8
QMS (83)	○ 42%	○ 7.8	○ 7.3	○ 7.4	○ 6.5
Star Micronics (80)	○ 9%	○ 8.0	○ 7.2	○ 6.7	○ 5.6
Tektronix (156)	○ 35%	○ 8.2	○ 7.8	○ 8.1	○ 7.1
Texas Instruments (77)	○ 47%	○ 7.5	○ 6.6	○ 6.4	○ 5.1
Xerox (77)	○ 42%	○ 8.2	○ 7.7	○ 8.1	○ 7.1

come a long way from its D grade two years ago, earns average scores this year on all three of the satisfaction measures, and its score for units needing repair in the past 12 months rises to better than average.

Panasonic's score for satisfaction with overall reliability drops to average this year, but the percentage of units needing repair in the past 12 months remains better than average. Star Micronics, which exited the mainstream PC printer market a few years ago to concentrate on its high-speed and point-of-sale dot matrix business, shows nearly unchanged scores from last year, with average scores for all three of the satisfaction measures and a better-than-average score for units needing repair in the past 12 months.

The grade of C indicates that a manufacturer has posted either average scores on all measures or a combination of average, better-than-average, and worse-than-average scores. Four vendors receive C's this year: Apple, Brother, Citizen, and Digital. Note that Digital sold its printer business to Genicom this past year, and we expect that company to join our survey results in the future.

Brother, one of only two vendors in our survey to climb a grade, rises from a D to a C this year thanks to the improvement in its score for satisfaction with repair experience. The grade of C is a drop for Apple, which consistently earned B grades for a number of years. In last year's survey, the vendor had a single above-average score, for satisfaction with overall reliability; this has now dropped to average.

Vendors that receive a D have posted a combination of average and below-average scores. This year, four manufacturers are in this stratum: Okidata, QMS, Tektronix, and Xerox. Okidata and Xerox both drop from C to D because of worse-than-average scores for units needing repair in the past 12 months; on the plus side, both achieve average scores on the three satisfaction measures.

Tektronix, which makes networked color printers—somewhat complicated and high-maintenance by nature—is experiencing a decline in its score for satisfaction with technical support from better than average to average. QMS has now received a D for three years running. This year, the grade is due to its below-

average score for units needing repair during the last 12 months. There has been improvement, however, in QMS's score for likelihood to buy again. Last year, QMS customers were the least likely of any in the survey to buy from the same manufacturer the next time around. This

Minutes on Hold

- Significantly better than average
- Average
- Significantly worse than average

Apple	○ 12.6
Brother	○ 9.1
Canon	○ 10.6
Citizen America	○ 10.0
Digital	○ 4.8
Epson	○ 9.8
Hewlett-Packard	○ 8.4
IBM	○ 7.2
Lexmark	○ 7.0
NEC	○ 9.2
Okidata	○ 9.5
Panasonic	○ 9.7
QMS	○ 13.6
Star Micronics	○ 5.7
Tektronix	○ 12.4
Texas Instruments	○ 6.9
Xerox	○ 8.2

Our Contributors: SAMANTHA J. EDWARDS is a project manager in *PC Magazine*'s research department, and JOSH LEVY is the staff editor for the hardware peripherals team. JAMIE M. BSALES was the editor in charge of this story.

112K Modems Have Arrived!



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The innovative SupraSonic II delivers Internet access to 112K by integrating two 56K modems on a single board. Just plug it into two ordinary phone lines for the fastest dial-up anywhere. Plus, the SupraSonic II includes Shotgun technology which monitors your phone activity, releasing your fax or voice line for incoming calls. Diamond also offers Shotgun-enabled 56K modems, like the SupraExpress, that can be combined with your existing modem for dual-line access speeds. Best of all, Diamond 56K modems feature other cutting-edge technologies for superior compatibility and performance. They're designed with the 56K standard (V.90) and Rockwell's K56flex technology for instant compatibility with your Internet service provider. In fact, national ISPs like Netcom already support Shotgun Technology. So, to get a jump on the crowds, get a Shotgun-enabled **Netcom** modem today.



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year, the score has improved significantly; it emerges in the average range.

The grade of E, which indicates below-average scores across the board, is rare in our surveys; no vendor has wound up with that grade for several years. Only Texas Instruments receives an E for 1998. This vendor's grade drops from a D received last year, thanks to a decline from average to below-average scores on three out of four satisfaction ratings. This makes sense, as TI exited the printer business several years back (selling to Genicom), and the installed base of printers is showing signs of age.

TECH-SUPPORT EXPERIENCES

Among those readers surveyed who have had at least one repair experience in the past 12 months, 48 percent say they contacted the manufacturer to have the problem solved, while 59 percent say they contacted someone else, such as a third-party service provider (some contacted both). The nature of the repair varied. 74 percent report that they needed to have a replacement part sent to them, have a technician come and fix the printer on-site, send the entire printer out for repair, or have a replacement printer sent to them.

Only 20 percent of the repair instances

Vendor Grades Past and Present				
	1998	1997	1996	1995
Apple	C	B	B	B
Brother	C	D	D	C
Canon	B	B	B	A
Citizen America	C	D	C	C
Digital	C	C	C	B
Epson	A	A	A	A
Hewlett-Packard	A	A	A	A
IBM	B	B	N/A	N/A
Lexmark	B	B	B	B
NEC	B	B	D	C
Okidata	D	C	D	B
Panasonic	B	B	B	B
QMS	D	D	D	C
Star Micronics	B	B	B	B
Tektronix	D	C	D	D
Texas Instruments	E	D	D	C
Xerox	D	C	C	N/A

N/A—Not applicable: This vendor was not represented in our published survey results.

EPSON AMERICA HEWLETT-PACKARD



The results of this year's Service and Reliability survey show that two printer vendors clearly take top honors across the board: Epson America and Hewlett-Packard. These companies receive above-average rankings in all four of our key measures: overall satisfaction with reliability of the printers, satisfaction with repair experiences with the vendors, satisfaction with technical support experiences with the vendors, and how many times in the past 12 months the printers have needed repair. Epson and Hewlett-Packard are the only vendors to earn a grade of A from our readers in each of the past four surveys.

Both vendors are also clear winners when it comes to readers' inclination to buy a product again from the same company. A full 75 percent of respondents who own Hewlett-Packard machines say it is "extremely likely" they'll buy from the company again. Epson rates a solid second on this measure, with a 60 percent of our respondents saying they are extremely likely to buy an Epson in the future (the next-nearest finishers, Canon and Lexmark, each receive 49 percent in this category).

Hewlett-Packard and Epson represent a majority of the survey pool as a whole; 55 percent of the printers our readers report on are HP printers, and 13 percent are from Epson. The two companies don't cover the same market segment, however. Of the Hewlett-Packard printers readers told us about, 55 percent are laser printers and 44 percent are ink jet units. Only 10 percent of the Epson printers in our survey are lasers and 65 percent are ink jets, with the remainder dot-matrix units.

our readers report could be resolved over the telephone. The good news is that you won't have to wait all that long to be told to send your printer back. The average time our readers have spent on hold before being connected to a live person was 9 minutes; Digital and Lexmark callers tended to get through more quickly than average (see the table "Minutes on Hold").

Interestingly, fewer than half of our readers (43 percent) feel that they spoke to a knowledgeable person. Xerox beats this average, with 52 percent of respondents indicating that the person on the other end of the phone was knowledgeable; only 14 percent of our readers are satisfied with the expertise of Citizen America reps, and only 21 percent of our readers who called IBM think the knowledge level was up to snuff.

On the plus side, only 13 percent of our readers feel that they got a run-around and were transferred excessively. Xerox does better than this average, with only 7 percent of our respondents indi-

cating that they got a run-around; 43 percent of those who responded to the question feel that they got a run-around from Citizen America.

BUY IT AGAIN?

In the end, the measure of how customers feel about a manufacturer is whether they would consider buying products from the same vendor again. This year, Hewlett-Packard once again comes out on top, with 75 percent of readers who used HP printers in the past two years saying it's "extremely likely" that they'll buy from HP again. For Epson, the other recipient of an A grade, readers are also more likely than average to pick the same vendor the next time around. Two other manufacturers, Canon and Lexmark, likewise receive better-than-average scores for future likelihood to buy. Nine vendors received merely average scores in this category. Four of the vendors receive below-average likelihood-to-buy scores: Apple, Citizen, Star Micronics, and Texas Instruments. **PC**



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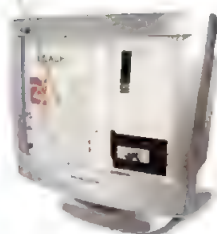
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Readers Rate Software Support & Satisfaction

In our annual survey, we solicit readers' opinions of the desktop software they use most and the quality of technical support.

By Samantha J. Edwards

Take a quick glance at the results of our seventh survey of Software Support and Satisfaction and you may be reminded of Sally Fields's famous Oscar acceptance speech: "You like me! You really like me!" By and large, *PC Magazine* readers are satisfied with the desktop software they use every day.

Of the approximately 7,000 readers who answered our survey, the majority rated their applications at 8 or higher (on a scale of 1 to 10) for overall satisfaction. And when we asked whether they would recommend a product to another user, the answers were also upbeat. Scores for technical support tended to be a little lower—mostly in the range of 6 to 7. But overall, as we've seen in previous years, readers are either too generous, happy with the user experience, or both.

That is not to suggest, however, that there isn't room for improvement in desktop applications. Just as we at *PC Magazine* are always looking for more from our

software, so are our readers. And when you drill down into individual product categories, it's clear that many vendors still have a lot of work to do.

Some other general observations are worth noting up front. First, after partially sitting on the fence last year, most readers have now made the switch to the 32-bit environment. Between 1997 and 1998,

the percentage of Windows 95 and Windows NT 4.0 users advanced significantly.

Second, software is not a popularity contest. In other words, the programs with the largest numbers of users do not always fare best. For example, Windows 95 earns a worse-than-average score for overall satisfaction, even though most readers use it and say they would recommend it to others. On the other hand,

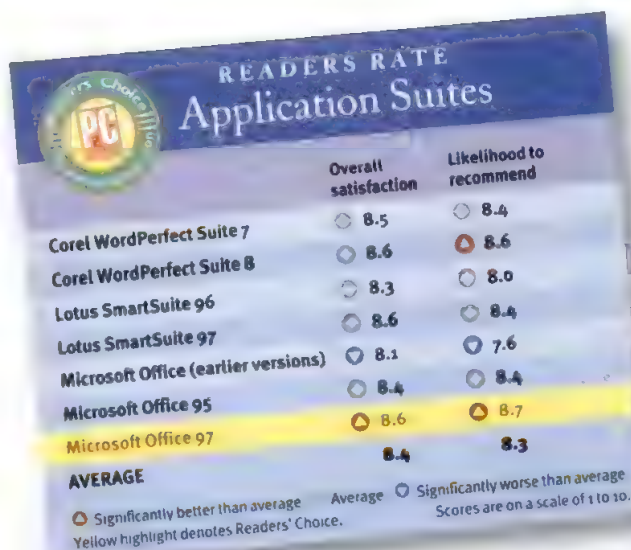
some products that enjoy a large market share—including Microsoft Office 97, Qualcomm's Eudora e-mail client, and Lotus Notes and Microsoft Exchange—deliver better-than-average satisfaction. And although Microsoft Internet Explorer has gained a lot of ground on Netscape Navigator in the wider market, *PC Magazine* readers still favor Navigator.



	Overall satisfaction	Likelihood to recommend
Apple Macintosh	8.6	8.4
Microsoft Windows 3.x	7.8	6.4
Microsoft Windows 95	8.0	8.3
Microsoft Windows NT 3.x	7.6	6.7
Microsoft Windows NT 4.0	8.4	8.5
MS-DOS	8.5	7.4
OS/2 Warp	8.1	7.4
Unix	8.8	8.4
AVERAGE	8.2	7.7

 Significantly better than average
  Average
  Significantly worse than average
 Yellow highlight denotes Readers' Choice. Scores are on a scale of 1 to 10.

www.pcmag.com Are you happy with the software you use and the service you receive? Come online and let us know.



Staying abreast of the changes in the software industry since we began surveying readers is no simple task. To keep up, we made some changes to this year's survey. For instance, rather than rating productivity applications (word processors, spreadsheets, and so on) individually, we looked at application suites as a whole—a more accurate reflection of the way customers purchase and use these integrated, core applications. Of course, the pace of innovation in Internet software makes office suites look as if they were standing still. Thus we carved out two distinct categories for e-mail: Internet e-mail and corporate messaging.

While readers seem satisfied with the state of desktop software as a whole, they still have strong opinions about the products they use and how vendors could do better still. Read our more detailed analysis below to find out how the applications you use stack up against the competition.

OPERATING SYSTEMS

It's a Windows world—at least among *PC Magazine* readers. In all, 94 percent of the readers say they use a version of Windows. The lion's share (76 percent) use Windows 95, but Windows NT 4.0 is also gaining ground, coming in at 9 percent. Windows 3.x ranks third, with 8 percent. Other operating systems trail far behind: Mac OS, MS-DOS, OS/2 Warp, Unix, and Windows NT 3.x each have fewer than 100 users (or 1 percent).

Our Contributors: SAMANTHA J. EDWARDS is a project manager in *PC Magazine*'s research department. Associate editor JOHN MORRIS was in charge of this story.

Not only are more readers using Windows NT 4.0, but there has also been an increase in their overall satisfaction with this environment. Users of Windows 95 are more critical, giving the OS a below-average score for overall satisfaction. Microsoft's older graphical operating systems, including Windows NT 3.x and Windows 3.x, also receive below-average scores for satisfaction from our readers.

One of the most telling questions on our survey is whether the respondent would recommend a product to others. In the case of operating systems, the products used most are also the ones readers recommend most. These include Windows 95 and Windows NT 4.0. As in previous years, a core of Mac OS, OS/2, and Unix loyalists give their operating systems average to above-average scores in this key area (Unix mavens also give it a better-than-average score for overall satisfaction). Time has clearly eroded support for Windows 3.x and NT 3.x, both of which garner below-average scores for likelihood to recommend.

In the area of overall technical support, Windows 95 and Windows NT have switched places this year. Windows 95 drops from average to below average, and its corporate cousin advances to average. Both products, however, receive below-average scores for written documentation—a trend we've noticed with Microsoft products in several categories, including application suites, Web browsers, and Internet e-mail.

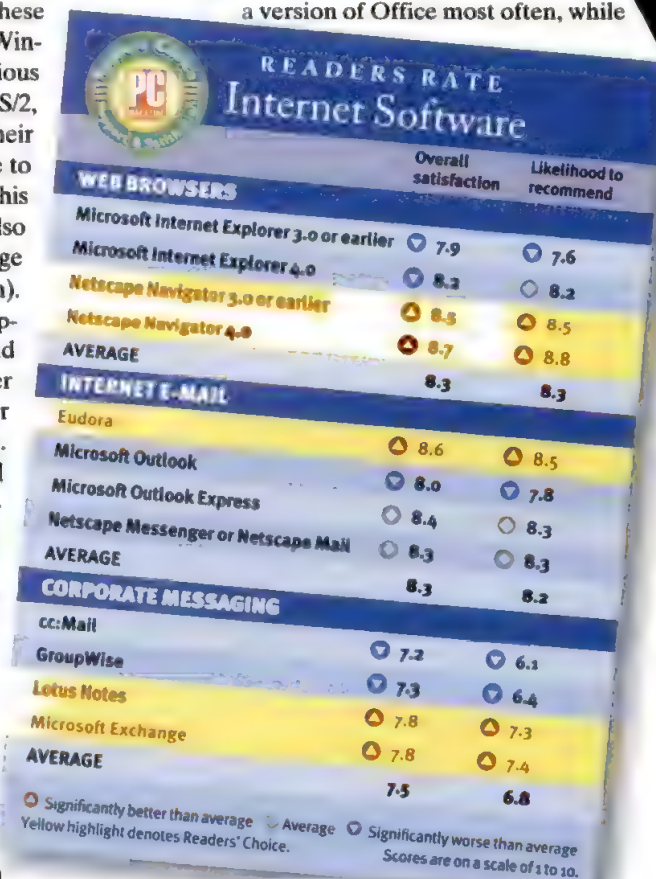
Most other operating systems receive average scores for overall technical sup-

port; the e-mail software, which scores a 7.5, is an open operation system variants (Digital VMS, SCO, and Solaris), really reflect the situation with any one vendor.

Oddly, the operating systems that readers say they recommend are also the ones that needed the most technical support. On the average, Windows 95 and NT 4.0 users received the most technical support in the past year, with 10 percent of the Unix users required

APPLICATION SUITES

It's no secret that Microsoft Office owns a large segment of the desktop environment. This year's survey affirms that fact: Nearly 80 percent of *PC Magazine* subscribers use a version of Office most often, while



10 percent use Corel WordPerfect Suite, and only 4 percent use Lotus SmartSuite. The remainder of the respondents use other suites, such as Microsoft Works or Apple's ClarisWorks.

In most categories, readers tend to be quick to embrace newer versions of prod-



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OPERATING SYSTEMS

MICROSOFT WINDOWS NT 4.0
UNIX

APPLICATION SUITES

MICROSOFT OFFICE 97

WEB BROWSERS

NETSCAPE NAVIGATOR
(ALL VERSIONS)

INTERNET E-MAIL

QUALCOMM'S EUDORA
(ALL VERSIONS)

CORPORATE MESSAGING

LOTUS NOTES
MICROSOFT EXCHANGE

Many of the desktop applications covered in our survey excel in one area or another, but only a handful rise to the top in all the key areas.

Last year, none of the major operating systems were deemed good enough to merit our Readers' Choice. This year, however, two of them make the cut: Microsoft Windows NT 4.0 and Unix. Windows 95 falls short of the mark, with below-average scores for overall satisfaction.

No matter how you look at office suites, Microsoft Office comes out on top. Last year, Microsoft Access, Excel, and Word all garnered scores good enough to merit a Readers' Choice. We merged these applications into a single category this year, and Microsoft Office 97 rises to the surface.

In the quick-paced Web-browser category, Netscape Navigator holds its own; all versions nab above average scores. Qualcomm's Eudora also makes a repeat appearance in this spot and, in the new Corporate Messaging category, Lotus Notes and Microsoft Exchange excel.

To earn Readers' Choice, a program must receive above-average scores on two critical questions: overall satisfaction and how likely the user would be to recommend the product to others. For more details on our survey methodology, see "How We Surveyed" in this issue's story "Readers Rate PC Service and Reliability."

ucts. But WordPerfect bucks that trend. The majority of the 662 respondents who say they use Corel WordPerfect Suite—about 70 percent—say they use Version 7, not the more recent Version 8.

Our overall satisfaction ratings indicate that, by and large, Microsoft Office has earned its dominant position. Office 97 is the only application suite to receive an above-average score for overall satisfaction. All other products (except versions of Office prior to Office 95) receive average scores; older versions of Office are deemed below average.

Along with Corel WordPerfect Suite 8, Office 97 is the product that readers recommend most. All of the other products garner average scores, except for older versions of Microsoft Office, which score below average.

Interestingly, the results are markedly different in the technical-support category.

SmartSuite 97 is the only suite to receive an above-average score. SmartSuite 96 and Versions 7 and 8 of WordPerfect Suite receive average scores. Tellingly, all versions of Office receive below-average scores for overall technical support. Users of the latest versions of Office and WordPerfect Suite—the two products most likely to be recommended—report needing technical support the most often.

WEB BROWSERS

By now, the so-called battle of the browsers has been widely chronicled. Although according to most estimates Microsoft Internet Explorer (IE) now rivals Netscape Navigator in overall market share, more *PC Magazine* subscribers use Navigator as their browser—albeit by a slim margin (49 percent for Navigator versus 46 percent for IE).



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SOFTWARE SUPPORT & SATISFACTION

It's clear that the browser category remains a two-horse race: Only about 5 percent of respondents say they use other Web browsers, such as America Online's built-in browser.

Not only are *PC Magazine* subscribers loyal to Navigator, but they also tend to give it higher ratings across the board. Both Navigator 4.0 and Navigator 3.0 or earlier receive above-average scores for overall satisfaction and likelihood to recommend. By contrast, IE4 and IE3 or earlier versions receive below-average scores for overall satisfaction.

The scores for technical support are equally polarizing. Again, all versions of Navigator get above-average scores for overall technical support, and IE is deemed below average.

INTERNET E-MAIL

A new section in our annual survey, Internet e-mail, is designed to elicit opinions on the POP3 e-mail clients that our subscribers use most often for personal and business communications. In this category, we included four major players: Qualcomm's Eudora (both Professional and Lite versions), Microsoft Outlook, Microsoft Outlook Express, and Netscape Messenger.

As we discovered when we surveyed the Web browsers category, *PC Magazine* subscribers are loyal to Netscape; the largest share (26 percent) say they use Messenger or Netscape Mail most often. Outlook ranks second, with 18 percent; Eudora has 13 percent; and 10 percent use Outlook Express. Interestingly, 33 percent of those who responded say they use some other Internet e-mail client. These others are most likely made up of online services, other POP3 clients, and Web-based e-mail services.

Eudora is one of the most popular e-mail clients available, so it's no surprise that users give it high marks across the board. It receives above-average scores for overall satisfaction, likelihood of recommending it to others, overall technical support, and written documentation. In addition, only 13 percent of the respondents say they needed technical support in the past 12 months.

By contrast, users give Microsoft Outlook below-average scores for overall satisfaction, likelihood to recommend to others, overall technical support, and written

documentation. The e-mail client/personal information manager hybrid also scores below average for the percentage requiring technical support in the past year: 22 percent altogether.

It should be noted, however, that our survey was completed before Microsoft shipped the new version, Outlook 98. Outlook Express, the e-mail client bundled with IE4, fares better, receiving average scores in most categories, as does Netscape Messenger.

CORPORATE MESSAGING

The corporate messaging category focuses on messaging products used in business settings, especially in larger organizations. In addition to e-mail, these products typically include such features as group calendaring and scheduling, threaded discussions, and the ability to create custom applications. We included four major messaging products: Novell's GroupWise, Lotus cc:Mail, Lotus Notes, and Microsoft Exchange.

The largest segment of respondents (31 percent) say they use Exchange most often, with cc:Mail trailing at 19 percent, Notes at 14 percent, and GroupWise at 10 percent of those surveyed. As we saw last year, the number of subscribers who say that they use Exchange most often does not seem to reflect its actual share of the market.

We suspect that this number may be partly inflated by users who actually use the Exchange client as an e-mail client but not as a corporate messaging solution in tandem with Exchange Server. As in the Internet e-mail category, a relatively large number of respondents (26 percent) say they use another corporate messaging product.

Both Notes and Exchange receive better-than-average scores for overall satisfaction. GroupWise has average scores, while cc:Mail receives worse-than-average scores. An above-average number of users say they would recommend Notes and Exchange. GroupWise again receives an average score in this category, as it does in most areas, and cc:Mail is below average.

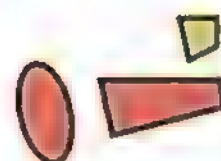
The only product to receive a better-than-average score for overall technical support is Notes. Exchange and GroupWise receive average scores for technical support, and cc:Mail again sustains a below-average score.



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Readers Rate Technical Support

The readers of PC Magazine demand a lot from their software and the vendors behind it. As the scores in our technical support section demonstrate, even vendors of the most widely used programs could do more to back their customers.

- ⬆ Significantly better than average
- Average
- ⬆ Significantly worse than average

Overall technical support % needing tech support in the past 12 months Written documentation Tutorials Support via the World Wide Web Support via online services or BBSs Built-in help function Telephone technical support

OPERATING SYSTEMS

Mac OS	⬆7.5	○23%	⬆7.2	⬆7.3	⬆8.0	⬆8.1	⬆7.0	⬆6.1
Microsoft Windows 3.x	⬆7.0	⬆17%	⬆6.5	⬆6.6	⬆6.3	⬆6.3	⬆6.4	⬆6.2
Microsoft Windows 95	⬆7.2	⬆29%	⬆5.6	⬆6.4	⬆7.1	⬆6.9	⬆6.7	⬆6.2
Microsoft Windows NT 3.1	⬆7.1	⬆21%	⬆6.1	⬆6.3	⬆5.9	⬆6.8	⬆6.4	⬆6.5
Microsoft Windows NT 4.0	⬆7.2	⬆38%	⬆5.9	⬆6.1	⬆7.5	⬆7.5	⬆6.6	⬆6.1
MS-DOS	⬆7.8	⬆5%	⬆7.2	⬆7.0	⬆7.3	⬆7.0	⬆6.6	⬆7.1
OS/2 Warp	⬆7.2	⬆31%	⬆6.3	⬆6.6	⬆6.8	⬆7.7	⬆6.6	⬆6.9
Unix	⬆8.6	⬆43%	⬆7.5	⬆7.1	⬆7.5	⬆6.4	⬆6.9	⬆8.0
AVERAGE	7.4	26%	6.6	6.7	7.0	7.1	6.7	6.6

APPLICATION SUITES

Corel WordPerfect Suite 7	⬆7.9	⬆21%	⬆7.1	⬆7.3	⬆7.1	⬆7.3	⬆7.5	⬆7.3
Corel WordPerfect Suite 8	⬆7.8	⬆30%	⬆6.8	⬆7.5	⬆7.2	⬆7.5	⬆7.6	⬆7.5
Lotus SmartSuite 96	⬆8.0	⬆16%	⬆6.9	⬆7.5	⬆7.1	⬆7.6	⬆7.4	⬆6.8
Lotus SmartSuite 97	⬆8.3	⬆24%	⬆7.1	⬆7.7	⬆7.8	⬆7.9	⬆7.7	⬆7.6
Microsoft Office (earlier versions)	⬆7.4	⬆20%	⬆6.8	⬆6.8	⬆7.0	⬆6.8	⬆7.1	⬆6.6
Microsoft Office 95	⬆7.4	⬆21%	⬆6.2	⬆6.7	⬆6.9	⬆6.7	⬆7.1	⬆6.6
Microsoft Office 97	⬆7.5	⬆25%	⬆6.2	⬆7.0	⬆7.5	⬆7.2	⬆7.4	⬆6.6
AVERAGE	7.7	22%	6.7	7.2	7.2	7.3	7.4	7.0

WEB BROWSERS

Microsoft Internet Explorer 3.0 or earlier	⬆7.2	⬆20%	⬆5.1	⬆6.0	⬆7.0	⬆6.9	⬆6.3	⬆6.1
Microsoft Internet Explorer 4.0	⬆7.4	⬆21%	⬆5.6	⬆6.5	⬆7.6	⬆7.3	⬆6.9	⬆6.6
Netscape Navigator 3.0 or earlier	⬆7.8	⬆17%	⬆5.9	⬆6.1	⬆7.5	⬆7.6	⬆6.6	⬆7.2
Netscape Navigator 4.0	⬆8.0	⬆18%	⬆6.4	⬆6.6	⬆8.0	⬆7.7	⬆7.0	⬆7.7
AVERAGE	7.6	19%	5.8	6.3	7.5	7.4	6.7	6.9

INTERNET E-MAIL

Eudora	⬆8.0	⬆13%	⬆6.8	⬆6.2	⬆7.5	⬆6.9	⬆6.8	⬆7.0
Microsoft Outlook	⬆7.4	⬆21%	⬆5.6	⬆6.3	⬆7.2	⬆6.8	⬆6.7	⬆6.4
Microsoft Outlook Express	⬆7.5	⬆19%	⬆5.3	⬆6.2	⬆7.4	⬆7.3	⬆6.9	⬆6.7
Netscape Messenger or Netscape Mail	⬆8.0	⬆12%	⬆6.2	⬆6.4	⬆7.7	⬆7.6	⬆6.8	⬆7.7
AVERAGE	7.7	16%	6.0	6.3	7.5	7.1	6.8	7.0

CORPORATE MESSAGING

cc: Mail	⬆6.7	⬆20%	⬆5.8	⬆5.5	⬆5.8	⬆6.4	⬆5.8	⬆6.3
GroupWise	⬆7.0	⬆28%	⬆5.8	⬆5.9	⬆6.8	⬆6.4	⬆5.8	⬆6.1
Lotus Notes	⬆7.6	⬆16%	⬆6.2	⬆6.5	⬆7.1	⬆6.6	⬆6.3	⬆7.5
Microsoft Exchange	⬆7.2	⬆20%	⬆5.6	⬆6.0	⬆7.0	⬆6.7	⬆6.4	⬆6.6
AVERAGE	7.1	24%	5.8	6.0	6.7	6.5	6.1	6.6



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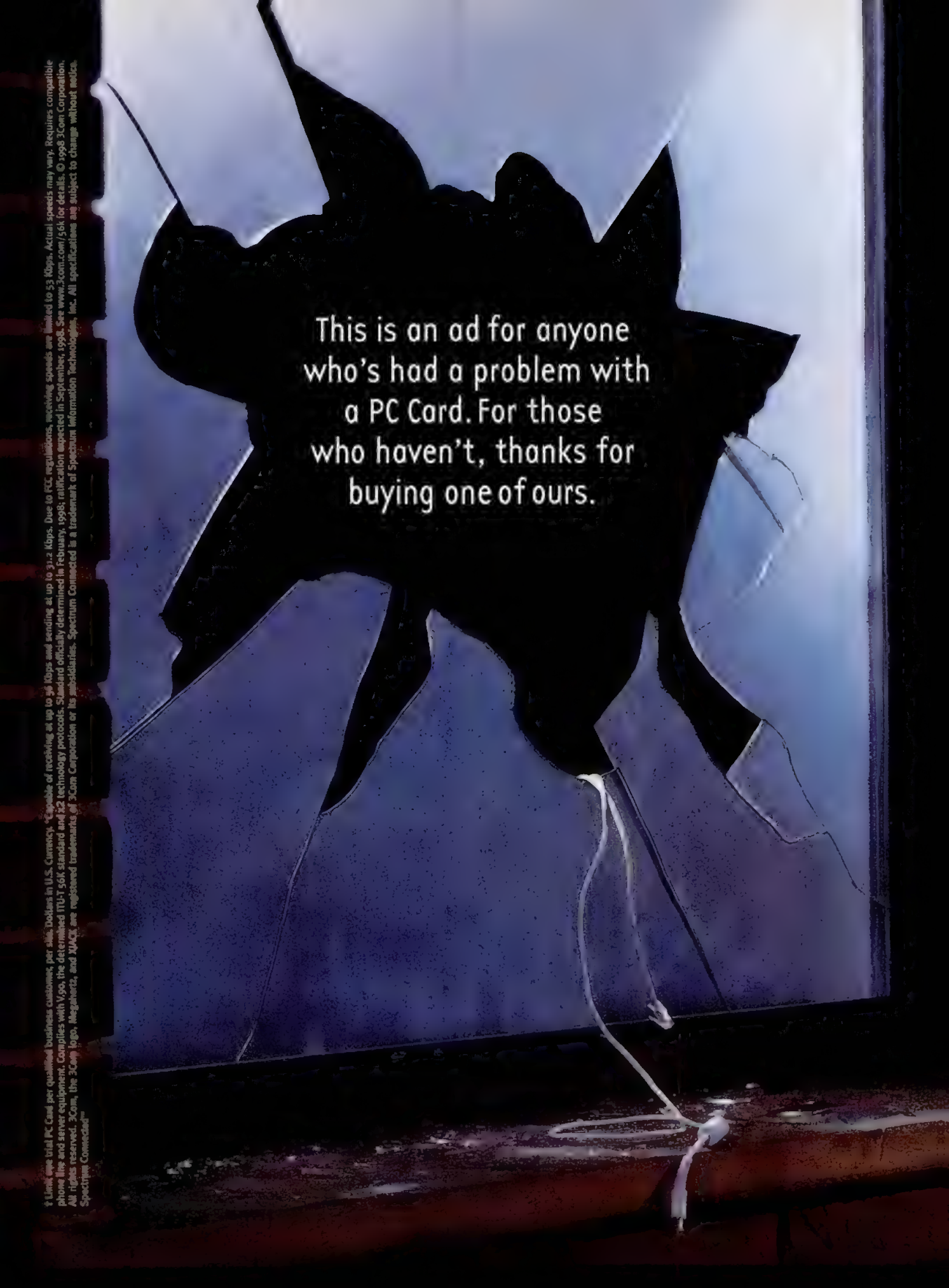
Matrox outperforms the competition	
Matrox Productiva G100 8MB (1999)	122
ATI Xpert Work 8MB (1999)	97
Diamond Viper V330 4MB (\$182) - N/S	
3Dfx Reality 334 4MB (\$134) - N/S	

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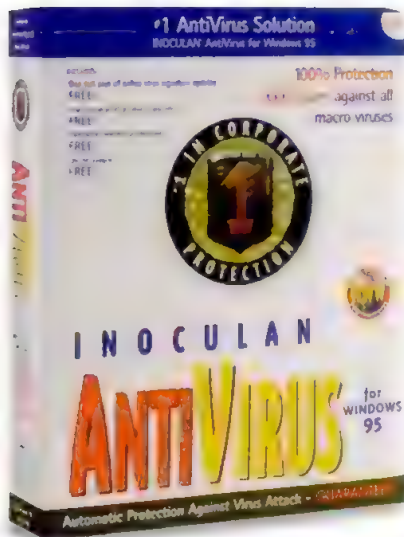


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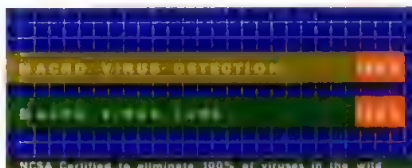


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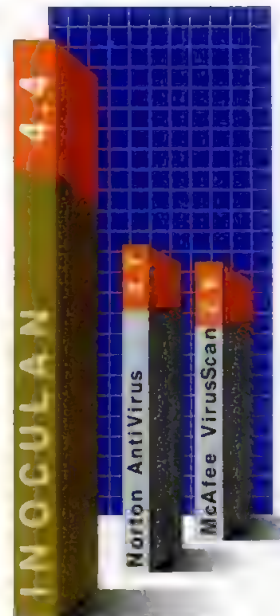
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INSIDE

WEB SERVER APPLIANCES

Now, almost anyone can set up an intranet. PC Magazine Labs tests four all-in-one hardware and software devices that make Web publishing easy. But are they good enough to beat traditional Web server solutions?

PRICED TO MOVE

Allied Telesyn has dropped the price per port, making its switch an attractive alternative to shared ports. Contributing editor Steve Rigney puts the



Allied Telesyn AT-3726 10/100-Mbps Ethernet switch through its paces to see what your dollar can buy. *Page 285.*

BRACED FOR THE MILLENNIUM

With January 1, 2000, close at hand, do you know whether your network will function properly? Steve Rigney examines BindView's NETInventory, a software product that tests your applications and hardware for Y2K compliance. *Page 285.*

SAVE THAT DATE Frequent contributor Robert P. Lipschutz evaluates Netscape Communications Corp.'s Calendar Server 3.5 and Open Text's Livelihood OnTime Enterprise 4.19. *Page 286.*

QUICK LINK Some jobs take just a simple tool. Contributor Craig Ellison tests the Psiber LANMaster 20, which checks the health of your Ethernet or Fast Ethernet link. *Page 290.*



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All files mentioned in this section are available for downloading from our Web site.

Web Server *Appliances*

Best suited to the workgroup, these mini-Web server solutions make setting up an intranet as easy as plugging in a toaster.

By Robert P. Lipschutz

What do you do if your workgroup needs to create an intranet but there's no Webmaster in the house? Consider a new class of turnkey Web server appliances. The products target non-technical users in departments, educational institutions, and small companies who want to avoid many of the complexities inherent in managing network operating systems and traditional Web servers.

As hardware and software solutions, these all-in-one devices combine hard disk storage (at least 2GB), Ethernet adapters, Web server software,

and a bundle of software utilities for site administration and content publishing. You simply plug the power cord into one of these compact devices, connect to your network, and go. Operating systems are built into the Web server appliances, but they're invisible to the user.

For our roundup, we tested four products that range in price from about \$1,200 to almost \$4,000. The Cobalt Qube 2700WG and the Microtest WebZerver target small, nontechnical groups and stress ease of use. The Data General Thin SiteStak TW-150 looks beyond the workgroup to focus on

ISPs and Web developers, and the Cisco Micro Webserver 200 does its best to attract both market segments.

On our tests, we found the devices best suited for a workgroup intranet. All but the SiteStak present a good alternative to traditional Web server solutions, providing an easy and cost-effective way to do Web publishing. The Qube, our Editors' Choice, even lets you drag and drop files to the intranet, making the product a possible replacement for or addition to your PC-based file servers.

A WELCOME ALTERNATIVE

Flat-rate ISP services and wizard-based Web authoring tools such as Microsoft FrontPage have long made it easy for individuals to set up personal Web sites. But the small and mid-size business wanting to deploy an intranet or establish a corporate Web presence has had a much tougher time in terms of site development and maintenance, as well as cost. Such companies have had to rely on the expertise of an on-site Webmaster or hire a consultant to set up a Web server on the LAN. And

though the commercial Web server market for intranets is dominated by Microsoft Internet Information Server (IIS) and Netscape Enterprise Server, neither product is the best fit for a small organization interested only in creating a small, private intranet.

Although IIS is free, it runs just on Windows NT Server, which costs around \$1,100 for a ten-user license—not counting the cost of setup and maintenance. Although Netscape Enterprise Server Standard Edition 3.5.1 won our Editors' Choice in this year's Web server roundup ("Web Servers," May 5), the product has a host of configuration options sure to overwhelm an inexperienced user. Moreover, it costs \$1,295, and that's without hardware. Though you can run many traditional Web servers on a 386-based system, a basic 233-MHz Pentium II from Compaq or Micron will add about \$1,700 to your solution.

Other Web servers, such as Apache HTTP Server 1.2.5, O'Reilly's WebSite Professional, and Sun's Java Web Server, require you to run

them on either a Windows or Unix platform. Though some of the servers are free, they require more expertise than the products reviewed here.

Another alternative is a competitive class of PC-based personal Web servers—Microsoft Personal Web Server, Netscape FastTrack Server, and O'Reilly's WebSite—that run on your desktop computer. The products have disadvantages, however. They require you to configure them as you would a Web server; also, you must always leave your system running, and you'll likely suffer a performance hit by serving out Web pages on the same machine as your desktop applications.

Web server appliances aren't just for small offices, though. These products also present a good solution for larger firms where Web content must expand but the IS department is overburdened. Also, self-contained departments such as sales or human resources can benefit from creating and maintaining their own intranets. (For additional ideas, see "Ten Uses for a Web Server Appliance.")

SUMMARY OF FEATURES

Web Server Appliances



■ YES □ NO Products listed in alphabetical order	Cisco Micro Webserver 200	Cobalt Qube 2700WG	Data General Thin Line SiteStak TW-150	Microtest WebServer
List price of tested configuration	\$1,595	\$1,249	\$3,990	\$1,595
General				
Processor type/speed	IBM PowerPC 403GA RISC / 33 MHz	MIPS 5230 RISC / 150 MHz	Pentium Pro / 166 MHz	AMD 5x86 / 133 MHz
Hard disk/main memory	2.1GB / 4MB	2.1GB / 16MB	2.1GB / 64MB	2.1GB / 8MB
Base operating system	Vxworks	Linux 2.0.27	Windows NT Server 4.0	Linux 2.0.27
Site Setup				
Installation wizards	■	■	■	■
Users and groups	■	■	■	■
TCP/IP configuration options	BOOTP, DHCP, RARP	DHCP	DHCP, RARP, Windows utility	BOOTP, DHCP, RARP
Connections	Console, SCSI, 10Base-T	Expansion slot, 10Base-T	10/100-Mbps Ethernet	SCSI, 10/100-Mbps Ethernet
Software Utilities				
Publishing tools provided	FTP	FTP	FTP	FTP, print-to-Web site
Publishing protocols supported	FTP	AppleShare, FTP, Windows file sharing	FTP, HTTP Put	FTP, HTTP Put, Windows file sharing
Includes HTML editor	■	■	■	■
Search	HTML, text	HTML, text	None	HTML, text
Other utilities	None	DNS, e-mail server (IMAP4, POP3, SMTP), threaded discussions	None	EazyPrint, discussion group
Server-side programming	CGI (TCL)	CGI (PERL)	FrontPage extensions, Perl, WinCGI	None
Administration and Management				
Access and error logs	■	■	■	■
Backup utilities	■	■	■	■
URL mapping and aliases	■	■	■	■
Administration methods	Browser, console, telnet	Browser, LCD with button pad, telnet	Browser	Browser

EASY, BUT NOT A TOASTER

Although these products are much easier to set up than traditional Web servers, they still require you to configure the TCP/IP information—address, subnet mask, host name—into the device, as well as add this information to the company's DNS server.

The products provide a variety of methods geared toward making configuration and administration tasks manageable for the less experienced user. All of them can use the Dynamic Host Control Protocol (DHCP) to assign an IP address automatically from the DHCP server on your network.

But if you use DHCP, be careful: Even if the DHCP server generates the TCP/IP address, your network administrator must assign a static or reserved address for the device. Otherwise, the DHCP server will assign a new IP address each time you reboot the Web server. Of the four products we tested, the Micro Webserver stands out by forcing you to assign a static IP address.

These products also include some higher-end functionality in addition to DHCP. They use BootP (Bootstrap Protocol) and RARP (Reverse Address Resolution Protocol), methods common in Unix-based networks and many ISPs. In addition, the Qube provides a convenient control pad with six soft buttons and an LCD for adding IP information.

Each of the products uses a browser-based administration interface to add users, groups, and Access Control Lists. The Micro Webserver and the SiteStak provide flexible

URL mapping that lets you replace the long directory names from the file system with simpler ones. The Qube and the WebZerver use similar schemes to organize directories. For example, the Qube sets up public directories for each group and a private directory for each user.

POSTING YOUR CONTENT

An integral part of the solution provided by Web server appliances is easy content publishing and file-and-directory manipulation. Although file transfer using FTP and HTTP Put is not complicated, the uninitiated will find the process unfamiliar. Generally, we expected the products to be farther along in providing drag-and-drop file manipulation. Only the Qube lets you create, move, copy, delete, and drag and drop files and directories just as you do on a file server.

Keep in mind, though, that most traditional Web servers can't drag and drop files to upload content either; Netscape Enterprise's utility Netshare is the exception. If posting content easily is essential to your workgroup, consider adding a product such as Net-It Central or Xerox Corp.'s DocuShare to provide this functionality.

All of the products include search utilities and engines to index the HTML and text pages stored on the Web server. The Qube, again the standout, includes an array of server software for DNS, e-mail, and threaded discussion. The WebZerver also has a discussion utility, EazyTalk. None of the products offers complete Web authoring tools. (The WebZerver bundles a trial version of NetObjects, and the Qube includes only a basic editor.)

The Micro WebServer, the Qube, and the SiteStak each include a CGI interface and an applications development environment that ISPs and developers might find attractive. But this segment is likely to gain more flexibility by using a traditional Web server on a PC platform.

All in all, we like the idea of point-and-shoot Web servers. But if you want to create a complete intranet or host a Web site from scratch, consider the products in our sidebar "More than the Average Web Server." There you'll find turnkey devices with built-in firewalls, e-mail servers, and other extras.

Cisco Micro Webserver 200

Unlike other Web server appliances that focus either on the workgroup or ISPs, the Cisco Micro Webserver 200, Version 1.0 (\$1,595 list), seeks to attract both market segments. We found the device easy to set up and were impressed with the wide range of tools included

EDITORS' CHOICE

• Cobalt Qube 2700WG



Each of the four Web server appliances we tested provides a simple yet effective alternative to traditional Web servers. But the Qube takes the lead as the

innovator in this class of IP devices. We found the Qube to be the most well-conceived and mature solution available. This little blue box packs plenty of powerful features, not to mention a number of unique extras as well.

Most impressive is the product's file and directory management capability. Although the other Web server appliances and traditional Web servers rely on traditional HTTP and FTP uploads to publish content, the Qube is visible on your network like any file server. This makes posting documents an intuitive drag-and-drop affair that even the most inexperienced user can accomplish. Moreover, the Qube is the only product reviewed here that is suitable for use as a traditional file server.

Setup was the easiest we experienced. In addition to an excellent browser-based administration tool, the Qube provides a unique LCD panel on the box, handy for inputting TCP/IP information. Cobalt also bundles a full complement of software that includes a threaded discussion server, a POP3 and IMAP4 mail server, and an HTML editor. In addition, there is a CGI and Perl for building server-side applications.

The other products in this roundup also have their share of good points. The Cisco Micro Webserver provides a GUI to configure MIME extensions; the WebZerver's EazyPrint feature presents a unique approach to uploading documents to the server; and the SiteStak provides a full array of tools that developers and ISPs will find useful.

for advanced users. Unfortunately, the Micro Webserver has weak points, such as the lack of a backup utility and sparse documentation that will confuse new users and leave more advanced ones unaware of its full capabilities.

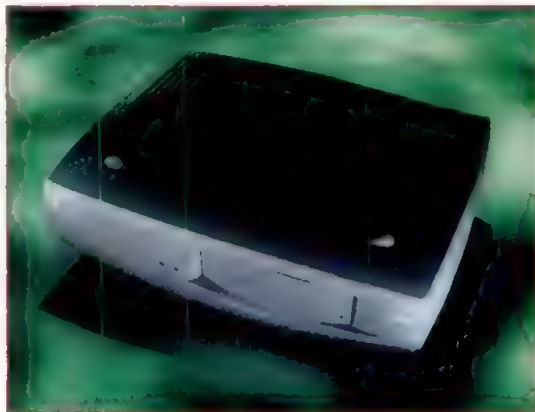
The phone-book-size box delivered acceptable performance using 4MB of RAM and a 2.1GB hard disk. As with the WebZerver, the Micro Webserver provides some level of expandability via a SCSI port to connect additional storage devices.

We found ease of setup to be the Micro Webserver's strong suit. Cisco is the only vendor here that provides color-coded ports and cables to eliminate mistakes. There are lots of choices for configuring TCP/IP: You can use the Network Wizard Windows utility, the administration console, or DHCP. (If you opt for DHCP, be sure to reserve a TCP/IP address on your DHCP server.)

Once configured, the administrative wizard makes quick and easy work of setting up user accounts and Web pages. Advanced user administration, such as setting up aliases and access controls, is performed through a Java-based configuration utility. To

store and access non-HTML files on the Web server, you must configure new MIME (Multipurpose Internet Mail Extensions) types. Though all the products provide this capability, the Micro Webserver is the only unit that provides a GUI to do so. But we found the utility to be awkward and slow, taking more than 30 seconds to load.

Beyond establishing users and pages, the Micro Webserver doesn't provide much assistance for content publishing. The problem was not so much the lack of HTML authoring



MICRO MACHINE: The Cisco Micro Webserver 200 has good capabilities but suffers from poor documentation.

PHOTOGRAPH BY THOM O'CONNOR



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WEB SERVERS

software—Cisco directs you to a number of shareware authoring utilities—as the skimpy documentation. Although the company claims the documentation is aimed at new users, it lacks key points that these users would find essential, such as how to use DHCP. Advanced users won't find the documentation helpful either; for example, there is no information on how to use the command line interface.

Although we liked that the Micro Webserver provides methods for publishing content geared to both workgroups and ISPs—FTP, HTTP Puts, and RCP and tFTP—the documentation doesn't reflect this versatility. There is no guidance on how to manipulate directories and no information on how to use RCP and tFTP. On our tests, we found that the shortcut aliases for directory names don't work with the FTP protocol.

The Java-based utility—used for viewing the server's directories, setting access control, and adding aliases—needs some improving. We were unable to change the size of the window, nor could we scroll to the bottom of our file structure using Navigator 4.05. (The utility works fine with Internet Explorer.)

Though we recommend Web server appliances as a workgroup and department solution, only the Micro Webserver provides tools geared to developers and ISPs, such as a CGI and TCL scripting language for developing server-side applications. For example, Cisco bundles a search interface based on CGI.

The Micro Webserver isn't too far from realizing its potential. Including a backup utility and improving the documentation and the Java utility will work toward making it an out-

standing product.—*RPL*
Cisco Micro Webserver 200, Version 1.0. List price: \$1,595. Cisco Systems Inc., San Jose, CA; 408-526-4000; fax, 408-

526-4100; www.cisco.com. Choose 901 at www.pcmag.com/infolink.

Cobalt Qube 2700WG



With the Cobalt Qube 2700WG (\$1,249 list), Cobalt demonstrates an impressive understanding of workgroup needs. The device provides an excellent browser-based administration interface and easy drag-and-drop publishing, as well as complete e-mail and discussion software lacking in the other products. The rich feature set is wrapped in an engaging cobalt-blue cube that is extremely easy to use and manage. The Qube wins our Editors' Choice.

The 9-inch Qube contains a 2.1GB hard disk and 16MB of RAM, though it lacked a SCSI port to add external storage, as seen in the Micro Webserver and the WebZerver. Despite this, we found the unit's performance acceptable for its target workgroup audience.

The configuration utility had us up and running in minutes. Entering TCP/IP information is a snap with the Qube's unique LCD panel and keypad. Alternatively, you can use DHCP or the administration interface. As with all the products except the SiteStak, the Qube also provides a command line interface for advanced users. But the

commands aren't documented, so you'll need to know Linux to use it.

You perform all configuration through an excellent Web-based administration interface. To add a user, you simply type in their full name, and the interface automatically creates a log-on ID based on the information. Putting a user in a group is as simple as clicking a check box, and you can even limit the hard disk space for each user. If you need assistance, the interface provides unique context-sensitive help that is activated when you drag your mouse over an option.



LITTLE BLUE BOX: The Cobalt Qube 2700WG packs unmatched functionality and ease of use into a 9-inch cube.

The product's best feature is its drag-and-drop publishing capability. Your users view the Qube as another desktop or server, and they can drag files into personal or group folders. Creating a directory on the server is as easy as making a new folder, whether on a PC or a Mac. If you prefer, you can also use FTP to send files up to the Qube.

The Qube's simple security model is appro-

SUITABILITY TO TASK

EDITORS' CHOICE

	Cisco Micro Webserver 200	Cobalt Qube 2700WG	Data General Thin SiteStak TW-150	Microtest WebZerver
Site setup	Good	Excellent	Excellent	Good
Application support	Fair	Good	Fair	Good
Administration and management	Good	Good	Fair	Fair

For **site setup**, we evaluate how simple the product is to get up and running. The device should be as easy to configure as a standard office fax machine, with high ratings going to products with installation procedures that take less than 30 minutes. Web server ports should be clearly labeled; color-coded cables are a plus. We consider both recommended methods and alternative offerings for assigning IP addresses. High marks go to products that use physical implementations such as keypads, which make keying in a number as easy as dialing a phone number. A software method (accessed via a browser or Windows utility) must auto-sense the device and guide the user through the process step by step. The product should offer DHCP configuration but not as the default procedure, as not all sites have this capability. The software

routes for performing administrative tasks should be systematic and forms-based.

For **application support**, products that allow dynamic Web pages receive high marks. We expect programming interfaces such as CGI and scripting tools such as Perl and TCL to be standard elements. Although traditional Web publishing methods via HTTP and FTP transfers are inherent in the products, a high mark goes to a product that provides an intuitive interface and documentation that firmly guides the inexperienced user. We look for publishing utilities that require no learning curve, such as drag-and-drop file sharing, and print drivers that integrate with existing desktop applications. Though a plethora of free and commercial utilities are available, we appreciate products that include bundled software

utilities for discussion, HTML editing, and canned templates for building pages.

Because the target market for Web server appliances typically doesn't have dedicated people for **administration and management**, high scores in this area reflect ease of use. Software interfaces should be intuitive and require no special training. Browser-capable utilities let you access the site locally or remotely for altering content or adding users and groups. We look for security that provides access controls on a read-and-write basis by user, group, and home-page directories. We're impressed by products that can perform self-maintenance based on criteria such as broken links or a disk-space shortage. Products should include simple-to-use backup utilities to safeguard content.

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priate for workgroups. Everyone has read access to all the group areas, which are accessed through the general home page. Users have write access only to their personal directories, as well as to the group directories the administrator assigns them.

The Qube comes with an extensive software bundle. It is the only product reviewed here that has a full mail server with both POP3 and IMAP4 client capabilities, and the package includes Cobalt's HTML-based threaded discussion tool.

Also included is a simple document manager called the InfoPlace Document Organizer that you can use to track multiple types of files. It doesn't have versioning, but it lets you track attributes—including author, keywords, and document summaries. Though the Qube features a basic HTML page builder, you'll want to use a third-party tool for any complex HTML operations. For programmers, the Qube includes a CGI and Perl for building server-side applications.

An excellent browser-based administration utility provides access to all the important functions and includes extensive system and content monitoring to check for things such as broken links. A backup utility makes it easy to save e-mail, user, group, and configuration data, either fully or selectively. The Qube is an

all-around winner, because it provides outstanding functionality without sacrificing ease of use.—*RPL*
Cobalt Qube 2700WG. List price: \$1,249. Cobalt Microserver Inc., Mountain View, CA; 888-702-6225; fax, 650-930-2501; www.cobaltmicro.com. Choose 902 at www.pcmag.com/infolink.

Data General Thiin SiteStak TW-150

Unlike the other products we tested, the Data General Thiin SiteStak TW-150 (\$3,999 list) is targeted to ISPs and centralized IS departments. Its biggest competition isn't other Web server appliances but a preconfigured PC with Web server software. We liked the SiteStak's convenience, simplicity, and power, but in the end, its high price and limited expandability make a traditional Web server the better choice.

Though the device is built upon an embedded Microsoft Windows NT Server 4.0 and IIS, it doesn't provide all the benefits of a full Windows NT server. You access the SiteStak through a browser interface that's easy to use, but it doesn't provide direct access to the Windows NT GUI or IIS administration programs. Furthermore, the SiteStak doesn't support the ISAPI and ASP programming environments you find in Windows NT.

The SiteStak's biggest drawback is its lack of expandability. The 64MB of RAM and 2.1GB hard disk may serve you now, but if you need to grow, you'll have to buy another \$3,999 unit. By contrast, the Micro Webserver and the WebZerver let you add external storage devices. And though the SiteStak has a thin form that makes it suitable for either rack-mounting or placement on a desk, its extremely loud fan prompted us to move the unit into the server closet with the traditional models.

One notable advantage over traditional servers, however, is the SiteStak's quick and easy setup. In place of documentation, the product points you to a Web site where you'll find step-by-step installation instructions. You can configure your server's TCP/IP address by using DHCP, RARP, or a utility available at the site. Using the utility, you simply enter the TCP/IP settings printed on the unit and the program automatically downloads the proper settings directly into the SiteStak. All subsequent configuration is performed through the

Net Tools

WEB SERVERS

browser. As with all the servers we reviewed except the Qube, you use FTP or HTTP Put to transfer files onto the unit.

ISPs will find the Web-based administration utilities good for use with multisite environments. The SiteStak is the only product here that lets you configure multiple virtual Web servers and assign separate domain names to each site. As you create new sites, the SiteStak creates users to administer and publish content to the site, letting you delegate site administration to individual owners. The SiteStak also has a convenient backup utility that can send an entire site via FTP—but not individual files or folders—to a backup location.

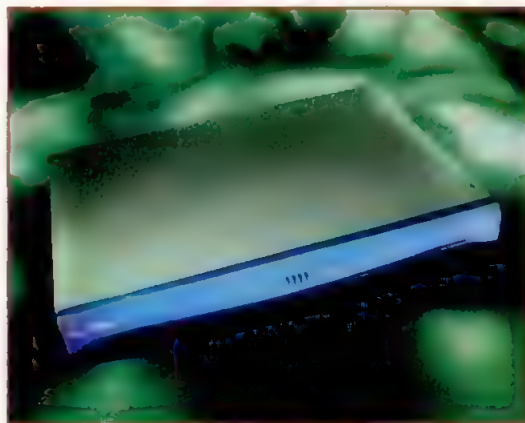
The SiteStak's authentication-based security is about average for this group of products. But ISPs that want to host commerce sites, for example, might be averse to the unit's lack of SSL support, and authenticating large numbers of users may prove impractical.

The product also includes advanced tools sure to attract ISPs and developers. In addition to Win32-based CGI programs and Perl scripts, SiteStak supports Microsoft FrontPage extensions. These extensions let FrontPage developers deploy their sites on the SiteStak with full functionality. Data General doesn't bundle any third-party content-creation tools with the product.

The SiteStak provides a powerful solution

10 Uses for a Web Server Appliance

- 1 Publish write-once/read-many documents on your intranet.
- 2 Develop and test Web pages or applications before deploying them on the Internet.
- 3 Provide an individual classroom or workgroup with its own Web server.
- 4 Create a portable Web server for trade shows and demonstrations.
- 5 Set up a public Web server without a path to the corporate network.
- 6 Host collaboration tools such as threaded discussions and centrally managed mailing lists.
- 7 Provide password-protected file transfers via an extranet.
- 8 Teach Web publishing.
- 9 Let nontechnical users maintain a Web server.
- 10 Implement the Web server as a remotely managed networking device for branch offices.



THE THIIN MAN: The Data General Thiin SiteStak TW-150 goes after the high-end ISP market.

that is easy to use and satisfies its target market, but if you need more than what's shipped in the box, a PC-based server is a better choice.—*John Garis*

Data General Thiin SiteStak TW-150. List price: \$3,999. Data General Corp., Westborough, MA; 888-878-4446, 508-898-4000; fax, 508-366-0750; www.thiin.com. Choose 903 at www.pcmag.com/infolink.

Microtest WebZerver

With its prebuilt templates and basic Web publishing tools, the Microtest WebZerver (\$1,595 list) is a decent solution for the network novice looking to get an intranet up and running quickly. Note, however, that installation can be tricky if your network isn't run-

ning BootP, DHCP, or RARP. And if you plan to get involved with any Web development, you will find more value in the less expensive, feature-rich Qube.

The WebZerver is a small, quiet box—about the size of an external disk drive—that fits nicely on a desk in an office environment. It comes with 8MB of RAM and a

2.1GB hard disk. You can add memory for a total of 64MB, and a SCSI interface lets you include more storage as found in the Micro Webserver. We found performance acceptable but slower than that of the other products we tested.

Setup is easy if your network is running DHCP, and WebZerver also supports BootP

ALTERNATIVE SOLUTIONS

More than the Average Web Server

In the main roundup, we look at turnkey Web server appliances that let you publish content on an intranet. Though these devices have many pluses, they do only part of the job. If you also need additional services such as e-mail, FTP servers, and a firewall, consider three products from Encanto Networks, eSoft, and Whistle Communications Corp.

Designed for small offices looking to quickly establish e-commerce sites, the **Encanto e.go** includes Web, e-mail, news, firewall/proxy, and FTP servers. The unit is available in two models, the Webstation (\$995 list) and Commerce (\$1,295 list) servers. In addition to the largest software bundle in this group, the Commerce model includes everything you need to make quick work of establishing a storefront.

The e.go is a snap to install and provides detailed documentation. We especially liked the browser-based setup wizard. The e.go is the only product here that lets you perform all tasks via a browser interface, so you can configure users and transfer files easily.

Although the e.go is good for setting up a storefront, it requires you to use the Encanto ISP. This nationwide service costs \$49.95 per month for analog access and \$79.95 per month for ISDN service, but the price includes only 2 hours of Internet access per day—with each additional hour costing \$1.49. This is fine for checking your storefront's e-mail but far too expensive for business Internet access. Also, the mail server is limited to only 25 e-mail accounts. (Encanto Networks Inc., Santa Clara, CA; 408-492-1212; www.encanto.com. Choose 905 at www.pcmag.com/infolink.)

The **eSoft Internet Protocol Adapter 1200 (IPAD)** line provides Web, FTP, firewall, e-mail, DNS, and DHCP services that can

serve a small office environment or integrate into an existing network. We tested the least expensive unit, the IPAD 1200 (\$3,809 list), which includes a 10-Mbps internal Ethernet adapter. You can also choose a leased-line interface or an x2 56K modem.



MORE THAN AN INTRANET: The InterJet 100, IPAD 1200, and e.go include additional services such as firewalls.

To install the IPAD, we simply attached the unit to our network and turned it on. We provided our ISP information through a browser and were surfing within minutes. Although initial setup is easy, configuring individual services such as adding users requires you to edit a control file manually using a text editor.

Unlike the other products we tested, IPAD includes two password-protected serial ports for attaching two modems—providing users with remote access to the corporate network. Also unique to this group, the IPAD mail server imposes no limit on the number of e-mail accounts you can create. Rather than let you transfer files with a browser interface as the e.go

does, the IPAD requires that you publish content via an FTP program. To ease this process, the IPAD includes the Common Internet File System (CIFS). (eSoft Inc., Aurora, CO; 303-699-6565; www.esoft.com. Choose 906 at www.pcmag.com/infolink.)

Priced at \$1,995 (list), the **Whistle Communications InterJet 100** was easiest to use of the products we tested and the most fun. New users will be comfortable with both its installation and upkeep. The unit contains Web, DHCP, e-mail, and preconfigured firewall servers but lacks an FTP server. The InterJet is unique here for including a four-port 10Base-T hub, making it an excellent home-office network and intranet solution.

The InterJet's capabilities are limited to the SOHO intranet. It provides services for 25 simultaneous users and includes a nonreplaceable 33.6-Kbps modem and a serial port for attaching an external ISDN modem. For faster connectivity,

you'll have to buy one of Whistle's higher-end models.

This device stands out from the group by including a display and keypad for performing configuration tasks. Once it was configured, we ran a simple Windows setup program. You can use either an FTP utility or a browser to publish Web content and set up e-mail accounts; we found the browser interface simpler to use. To ease content creation, the InterJet bundles a copy of Claris Home Page and a trial version of NetObjects Fusion. (Whistle Communications Corp., Foster City, CA; 888-494-4785, 650-577-7000; www.whistle.com. Choose 907 at www.pcmag.com/infolink.)—Steve Rigney

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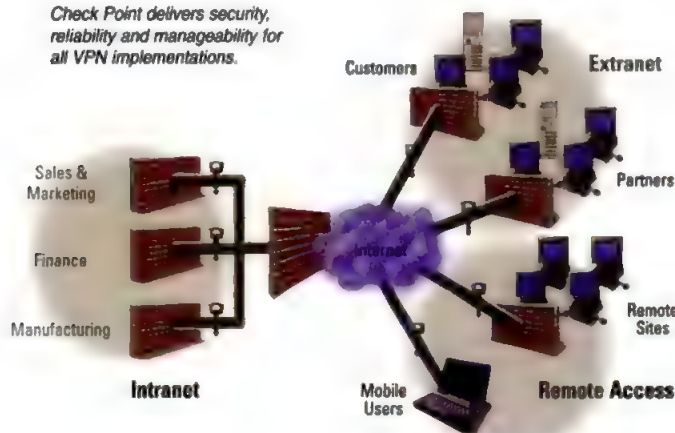
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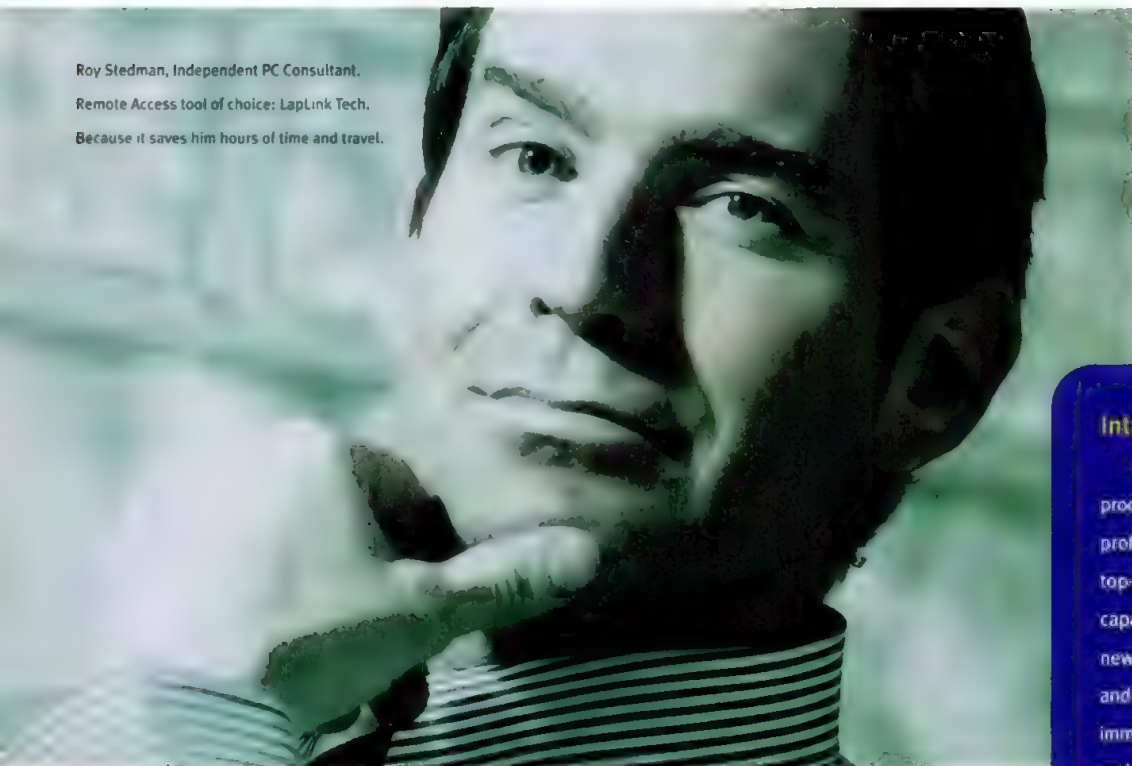
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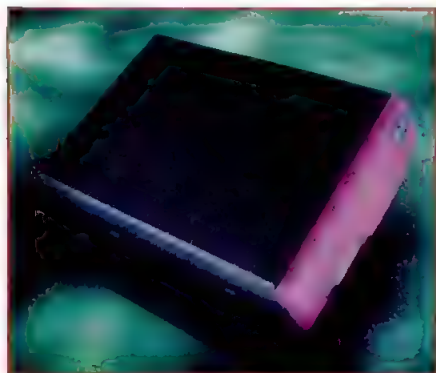
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and RARP to auto-load a TCP/IP address. Unfortunately, when we tried setting up the unit without running these protocols, things got pretty complicated. We had to change the IP address of our Windows NT client to match the WebZerver's built-in subnet, connect to the WebZerver from our Windows NT browser, configure the WebZerver's IP address, and then change our Windows NT client IP address back again.

Once you get past that hurdle, configuration is relatively painless. A Web site installation wizard generates an administrator account, configures security, and creates a site layout. Security is basic yet functional; users can either get read/write access to the entire site or read-only access to the site.

The WebZerver's wizards lack flexibility, but they do let you customize the basic look and feel of your site with elements such as



SMALL WONDER: The Microtest WebZerver is about the size of a removable storage drive.

folder titles and background images. You can then add your own custom pages using the included 30-day trial version of Net-Objects Fusion, Version 2.01, or any other Web authoring tool.

One innovative WebZerver feature is EasyPrint, which installs as a printer driver on your Windows system. You can use it to post digital images of documents from applications such as Microsoft Word directly to the WebZerver in a directory you specify. Users can then view the images using any Java-enabled browser.

The WebZerver includes a basic search facility and an HTML-based discussion board. To transfer files to the WebZerver, you use standard FTP or HTTP Put, which is a little more difficult than the Qube's drag-and-drop file transfer capability. The WebZerver does have Windows file-sharing capability for backup purposes.

We found the Web-based administration interface intuitive and easy to use. The WebZerver also has telnet running in the box, but this is purposely not documented, as it's

intended for tech support's debugging purposes and for potential licensees.

The WebZerver is not a good platform for Web development, because it does not support CGI, SSI, or other development APIs. If your group is looking for those capabilities or doesn't want to use the WebZerver's intranet paradigm, it would be better off con-

is definitely worth a look.—JG

Microtest WebZerver. List price: \$1,595. Microtest Inc., Phoenix, AZ; 800-526-9675; fax, 602-952-6401; www.microtest.com. Choose 904 at www.pcmag.com/infolink. **PC**

Net Tools

WEB SERVERS

sidering the Qube. But if you are seeking a basic intranet and have the appropriate network configuration, then the WebZerver

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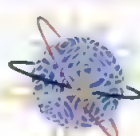
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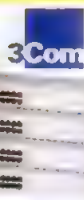
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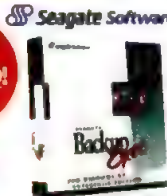
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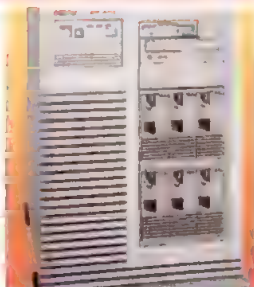
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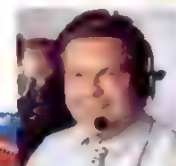
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333MHz Pentium II	64MB ECC	IDE	24X	\$2798.22	100995

RAM upgrade	Price	CDW
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300MHz Pentium II	32MB	4.3GB	SCSI	Max	10/100	\$2429.00	100886

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- Integrated Wide-Ultra SCSI controller
- Support for up to three 1.6" or 1" hot plug hard drives
- Expansion slots: 2 PCI; 4 shared PCI/EISA
- Integrated Remote Console (IRC)
- 3-year on-site limited warranty

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CPU	RAM	Hard drive	Ethernet	Price	CDW	
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300MHz Pentium II	64MB	-	10/100	\$2899.00	100886	
300MHz Pentium II	64MB	-	10/100	\$3399.00	100887	



Compaq RAM upgrades

- 16MB EDO RAM kit
CDW 73185
- 32MB EDO RAM kit
CDW 73194
- 64MB EDO RAM kit
CDW 73195

ProSignia 200 Small Business Server

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266	32MB	4.2GB	24X	\$2297.65	105343	
300	32MB	-	24X	\$2397.65	105344	
300	32MB	4.2GB	24X	\$2497.65	105345	
300	64MB	-	24X	\$2597.65	105346	
300	64MB	-	24X	\$2697.65	105347	

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Net Tools

FROM THE BENCH

ETHERNET SWITCHES

A Switch for All Budgets

By Steve Rigney

The dramatic fall in switch prices has prompted many companies to install them in locations formerly reserved for hubs. One of the leaders in this charge, Allied Telesyn International Corp., recently brought its AT-3726 switch to market at \$1,195 list, or \$48 per port.

Though the AT-3726 is priced for small networks, it offers a feature set usually found only in higher-end solutions. It includes an integrated mirror port and has the ability to use either cut-through or store-and-forward modes. Cut-through switches provide lower latency, and store-and-forward devices provide better protection against propagation of bad packets. You switch between modes by using a termi-

with quick status information.

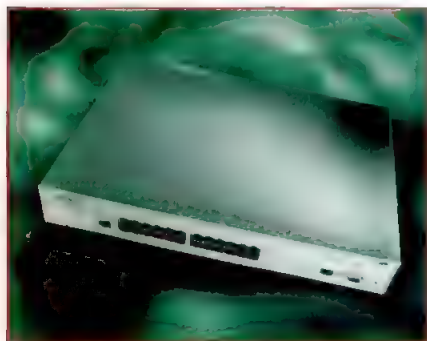
The management interface let us manually set the individual ports to run at half- or full-duplex and use NWay auto-sensing to determine the duplex speed automatically. An integrated mirror port lets you connect an RMON probe or LAN analyzer to the switch for network management and troubleshooting. The mirror port, however, lets you monitor only a single switch port at a time. ATI plans to add Web-based management and a built-in Web server by press time, but these features weren't included in our test unit.

The AT-3726 can learn up to 2,000 MAC addresses, probably more than you'll ever need. To improve performance, the switch stores requested addresses in its 4MB buffer. If a store address is not requested for 5 seconds, it is purged from the AT-3726's buffer.

A couple of minor points detract from the product. The package lacks a basic serial cable and power cord (only about \$25 worth of equipment), and the documentation is skimpy. Although ATI provides detailed docu-

mentation on its Web site, this fact is buried in the manual.

Allied Telesyn AT-3726. List price: \$1,195, or \$48 per port. Allied Telesyn International Corp., Sunnyvale, CA; 800-424-4284, 408-730-0950; fax, 408-736-0100; www.alliedtelesyn.com. Choose 908 at www.pcmag.com/infolink.



HIGH-END FEATURES: The AT-3726 provides easy management as well as a mirror port.

nal or a telnet connection.

The AT-3726 comes in a 19-inch rack-mountable chassis with 24 10-Mbps Ethernet ports, a 100-Mbps port, and a slot for a 100-Mbps twisted-pair connection (\$79 list) or fiber-optic connection (\$329 list). Each port has a dual-LED that provides you

YEAR-2000 COMPLIANCE

A Centennial Checkup

By Steve Rigney

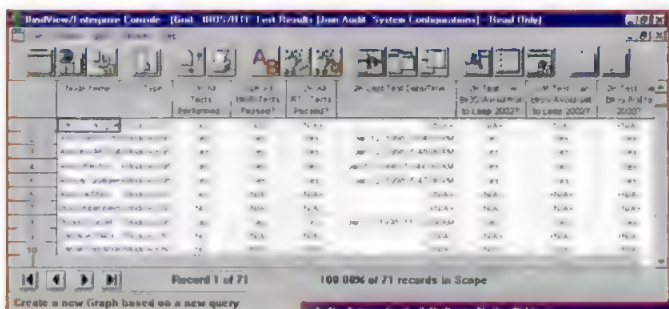
In case you haven't started checking your network for year-2000 (Y2K) compliance, the clock is ticking. To this end, BindView Development Corp. has added Y2K-compliance testing of software as well as BIOS and real-time clock (RTC) to its popular application NETInventory.

NETInventory's detail-auditing and analysis tools are good, but we weren't too impressed with the

invest in at least one EMS console, which costs \$1,995 list.

In order to run, NETInventory requires you to have the latest version of NetWare Client32 loaded on all your PCs. Like many administrators, we had Microsoft's NetWare client (not included) loaded on our test systems. Installing Client32 on all of them took considerable time.

The product consists of three types of software-based servers:



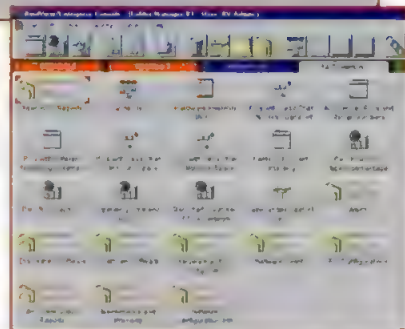
TRIED AND TESTED:

NETInventory displays the Y2K compliance of network clients and installed software.

product's overall Y2K capabilities. Although the program has 16 useful tests for a system's BIOS and RTC, it doesn't check individual files or open applications to determine their Y2K compliance. Instead, it only checks your programs against a database of known compliant software titles. We found this approach incomplete—and useless for those who rely on business-specific or vertical applications.

Moreover, NETInventory's documentation is sparse and presumes that users have preexisting knowledge of the product. We would like to see future iterations of the program less reliant on NetWare and better integrated with Microsoft Windows NT and OS/2 clients.

NETInventory (\$1,775 list for a 100-node license), a component of the BindView EMS/Enterprise Console package, requires you to



MORE THAN A DATE CHECK: NETInventory offers a host of network inventory features.

Login, Audit, and Master. The Login servers—which can be located on a NetWare or Windows NT server—execute auditing agents whenever a user connects to a Login server. This inventory data is then stored in one of the Audit servers located on a NetWare server.

A single Master server keeps track of all of the NETInventory servers and synchronizes the data across them. Note that the Master server must reside on an Audit server. It's also a good idea to install the Login server on all your servers to ensure that each time users log on to the network, they

CROSS

TALK



Frank Dertter

Leon, the moment of truth for year-2000 fixes is nigh. Yet only now are we beginning to see shrink-wrapped applications, such as BindView's NETInventory, that actually help you deal with the problem. If you haven't moved on the Y2K problem yet, you're going to be in for big trouble.

That's right, Frank. Anyone who thinks Y2K is a COBOL programmer's problem is living in denial. Testing PC hardware is the easy part. But there are thousands of software applications and data files on everyone's networks that need to be examined. The sooner you start checking, the better.



Leon Erlanger

execute the audit agent.

To check your hardware on Windows 95, Windows 3.x, and DOS systems, NETInventory installs an agent on the client that runs several tests on the BIOS and real-time clock of the motherboard upon log-on, such as seeing if the system will automatically roll over to January 1, 2000, or if it needs to be set manually. Unfortunately, NETInventory can't perform this test automatically on PCs running Windows NT or OS/2. Those users will have to boot the system from a disk created using the NETInventory console.

NETInventory's compliant-software program database includes 28,000 titles, ranging from DOOM 1.0 to the German ver-

sion of Lotus 1-2-3. BindView also posts monthly updates to the database on its Web site, free for download. The program provided us with detailed reports that we liked. Compliance data can be viewed in real time or used to create graphs and charts that you can save for later use.

NETInventory 5.2. List price: 100-node license, \$1,775; single EMS console, \$1,995. Requires: 486-based PC or better, 16MB RAM, 40MB hard disk space, Super VGA resolution (800-by-600) or higher, Windows 3.x or later, and NetWare 3.11 or later. BindView Development Corp., Houston; 800-749-8439, 713-881-9100; fax, 713-881-9200; www.bindview.com. Choose 909 at www.pcmag.com/infolink.

ENTERPRISE CALENDARING

Keeping Up to Date

By Robert P. Lipschutz

In business, consensus is king. And the way to reach a consensus, like it or not, is to hold a good old-fashioned meeting. We review Netscape's Calendar Server and Open Text's Livelihood OnTime Enterprise, enterprise calendaring products designed to make scheduling meetings easy—whether you connect through your LAN, over the Internet, or even via your PalmPilot.

Unlike Lotus Notes and Microsoft Schedule Plus, both of which use a messaging replication mod-

el, these two products use real-time appointment scheduling across a company. This means that you will always have someone's latest schedule, even if they're on the opposite coast.

Netscape Communications Corp. Calendar Server

Netscape's Calendar Server 3.5 provides a strong calendaring solution best suited to enterprise environments that rely on LDAP as a central directory. We liked the product's flexible off-line



abilities, as well as its convenient PalmPilot integration. But if LDAP support isn't essential, you'll probably prefer OnTime's more intuitive interface.

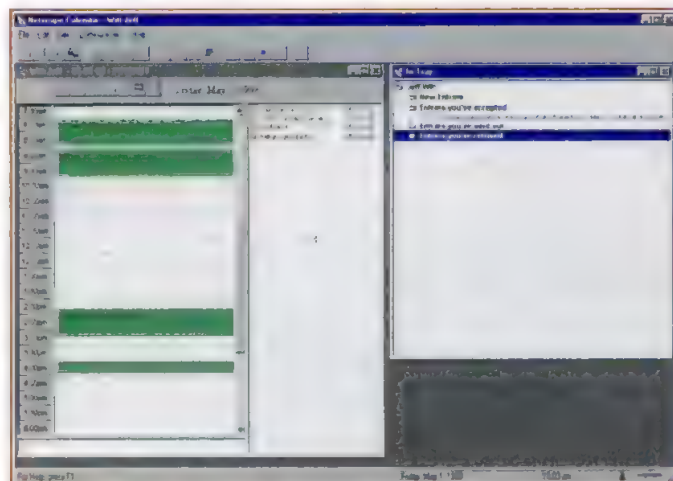
Part of Netscape's SuiteSpot family of servers, Calendar Server (starting at \$1,750 list for a 50-user license) can also be used as a standalone server. Unlike OnTime, which supports multiple NOS directories, Calendar Server relies entirely on the LDAP-based Netscape Directory Server, which is included with the product. We tested the Microsoft Windows NT version of Calendar Server; Netscape also offers versions for AIX, HP-UX, Irix, and Solaris platforms.

Though Calendar Server's Windows-based client keeps track of your meetings, tasks, daily events, and daily notes, we

and confidential. You can control the amount of information users can view on your calendar by granting access rights to individual users. Although there is no way to grant access rights to groups in this version, we hope to see this capability added to the next release.

Calendar Server provides several capabilities geared to remote and mobile users. The replication option lets you copy your calendar entries from the server to your local machine for working off-line. Unlike OnTime, Calendar Server lets you copy other users' entries. When you reconnect to Calendar Server, any new appointments you made will be synchronized with your calendar on the server.

There's also a CGI application called Calendar Express that lets you access your calendar from a Web browser. The Web-based interface is less convenient to use than the Windows-based client, and it's not as well devel-



A MATTER OF FINE PRINT: To view your entire schedule, Calendar Server's Windows client sometimes requires you to reset your monitor resolution.

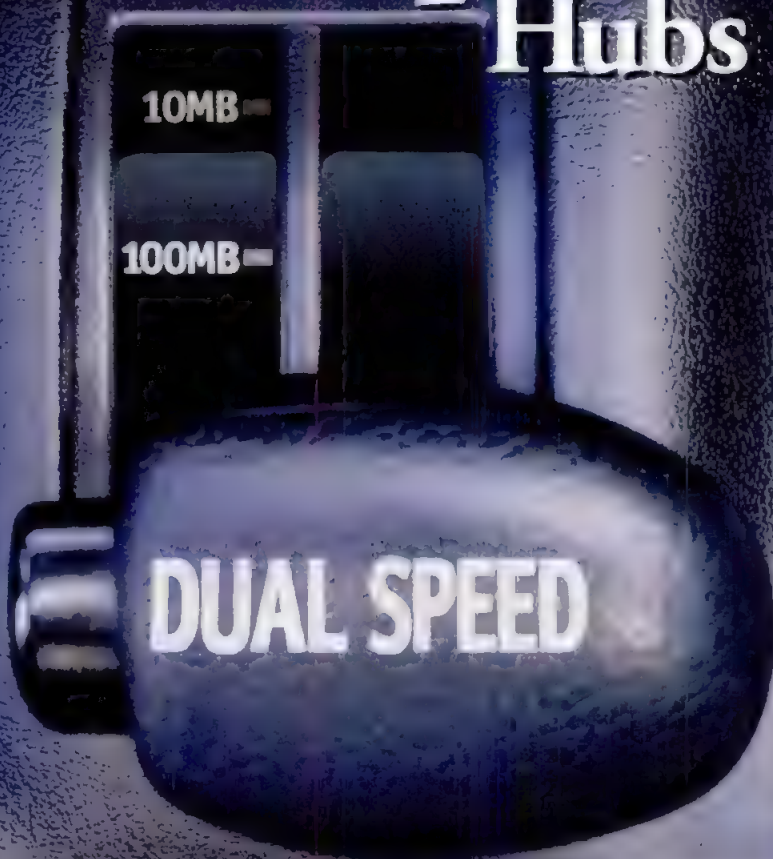
found the interface harder to use than OnTime's. Meeting descriptions disappeared when we reduced the Calendar window size. And when we invited other users to our meetings, we found the LDAP interface difficult to navigate. Most end users will likely find some of LDAP's nomenclature unfamiliar.

Calendar Server provides three privacy levels: normal, personal,

oped as OnTime's Web-based client. We found the interface better for viewing meetings than for adding them. Since much of the information needs to be added manually in multiple steps, we found adding new meetings somewhat frustrating. We had to wait a bit too long between screen submits to make this an ideal solution.

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Calendar Server's ability to synchronize with the PalmPilot. Calendar agenda entries, tasks, and daily events become PalmPilot date and to-do entries. This functionality is provided via a free download from Netscape's Web site. Although there is no integration with Windows CE 2.0 PIM devices in this version, Netscape plans to release a software developers' kit soon to provide this.

Calendar Server 3.5. List price: 50-user license, \$1,750. Requires: For servers, 32MB RAM, Microsoft Windows NT 3.51. For clients, 16MB RAM; Windows 95, Windows NT, Macintosh, or Unix. Netscape Communications Corp., Mountain View, CA; 800-638-7483; 650-937-2555; fax, 650-937-2112; www.netscape.com. Choose 910 at www.pcmag.com/infolink.

Open Text Corp.

Livelihood OnTime Enterprise

If a calendaring product is unfamiliar or difficult to use, your users might go back to their day planners. OnTime Enterprise 4.1 touts an intuitive Windows interface that will put your users on familiar ground. The current version runs on Microsoft Windows

Net Tools

FROM THE BENCH

NT, NetWare, and VINES and integrates with the directories of each NOS. OnTime Enterprise provides a complete solution that's tough to beat in most areas.

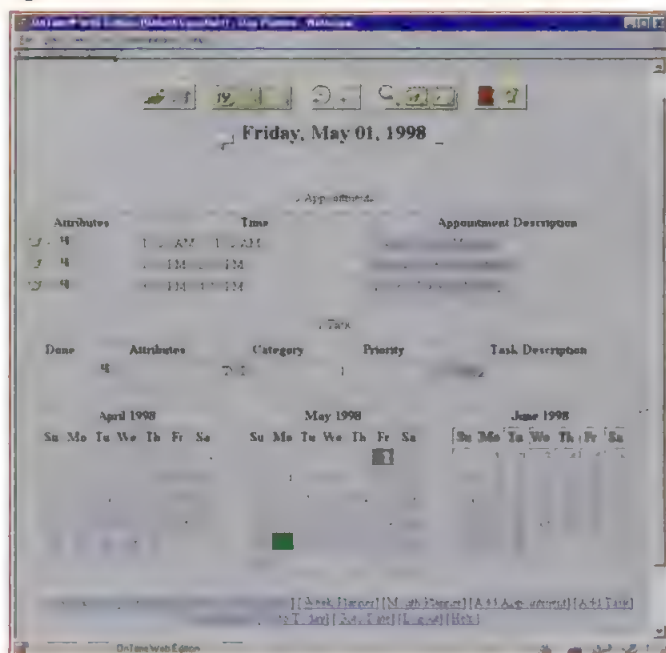
Open Text takes a different tack than Netscape in marketing its enterprise calendaring solution. Instead of going with a relatively low-price fixed-user license with charges for additional users, the company sells On Time on a per-server basis (\$25,000 list) with an unlimited user license.

We installed both OnTime Enterprise and Web Edition on our Windows NT Server. The process was straightforward and much easier than installations for other groupware products. OnTime's Windows client interface is superior to Netscape Calendar Server's. We set up group meetings and tasks easily and found inviting users and scheduling resources intuitive. For example, when you schedule a group meeting, OnTime presents you with a directory of users, private groups, and public groups from which to choose. Once you make your selections, OnTime shows you the available

time slots for your meeting.

We especially liked the ease of use and flexibility of the Windows-based user interface. Appointments and tasks are clearly laid out on the screen, with a helpful reference calendar on the right. When we shrank the win-

ments. A future enhancement will let users synchronize with OnTime via the Pilot cradle. OnTime also integrates with the AT&T Pocket-Net phone, so users on the road can view OnTime appointments. Windows CE support is not currently available, but it is in the works.



SIMPLE ELEGANCE: Open Text's OnTime comes with a clean Web-based client that makes reading your schedule a snap.

dow size, the font size shrank as well, which let us see the meeting descriptions even when using the one-week view. As with Calendar Server, OnTime lets you view multiple calendars simultaneously. But unlike the Netscape product, which provides three layers of privacy, OnTime provides seven. With these, you can grant users the ability to view your free and busy times, view only specified meetings, and even schedule appointments for you.

The Web access component works with Versions 3.0 or later of Internet Explorer and Netscape Navigator. Though the interface doesn't compare with that of the OnTime Windows client, it's much better than Netscape's Web client.

Although OnTime provides PalmPilot integration, Piloteers will be disappointed with the capabilities in the current version. You must use the import and export features to synchronize appoint-

ments. OnTime's replication feature works well, letting mobile users copy a calendar to the local hard disk, then resynchronize it with the server when they return to the office or via a remote dial-up connection. Although Calendar Server lets you replicate another user's calendar on the road, OnTime lets you synchronize only your own appointments.

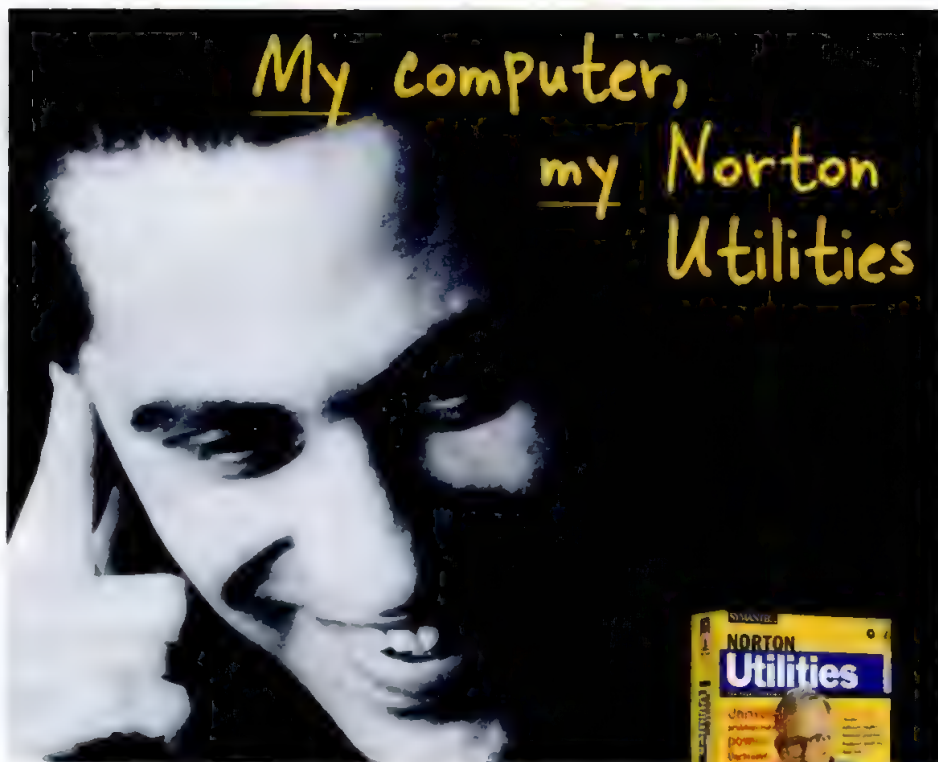
While the Netscape product relies on Directory Server for its security features, OnTime includes Checkpoint SecuRemote for secure connections from the road. SecuRemote works with Checkpoint's Firewall-1 to create a VPN for authenticated and encrypted connections.

Livelihood OnTime Enterprise 4.1. List price: \$25,000 per server (unlimited users). Open Text Corp., Waterloo, Ontario, Canada; 519-888-7111; fax, 519-888-0677; www.opentext.com. Choose 911 at www.pcmag.com/infolink.

SUMMARY OF FEATURES

Enterprise Calendaring

	Netscape Communications Corp. Calendar Server 3.5	Open Text Corp. OnTime Enterprise 4.19
■ YES ■ NO		
Starting list price	For 50 users, \$1,750	For unlimited users, \$25,000 per server
Server platforms		
NetWare/Windows NT	■ ■	■ ■
Unix/VINES	■	■
Client platforms		
Windows 3.x/Windows 95/Windows NT	■ ■ ■	■ ■ ■
Macintosh/Unix	■ ■	■
Supported directories		
NetWare/Windows NT	■ ■	■ ■
LDAP/VINES	■ ■	■
Schedules resources/sends invitations	■ ■	■ ■
Resolves conflicts	■	■
Shared calendar views	■	■
Web client	■	■
PalmPilot/Windows CE integration	■ ■	■ ■
Supports users on different servers	■	■
Supports working off-line	■	■



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LINK TESTER

Locating the Missing Link

By Craig Ellison

If you're looking for a quick-and-dirty way to ensure that your Ethernet network connections are live, consider the Psiber LANMaster 20 link tester. Retailing at \$150, this compact, one-button Ethernet link tester isn't meant to troubleshoot all the problems that a protocol analyzer can, but it does a good job of identifying link and fault status. Its ease of use, speed, and affordable price make this wand-like device a must-have for your network toolbox.

Pushing LANMaster's button initiates a test sequence that first checks for a hub connection. If it doesn't detect one, it then checks the network adapter cards. A typical link test takes less than 3 seconds. In that time, LANMaster determines the connection's

link status, Fast Ethernet capabilities, and fault status. But don't let the speed lull you into thinking that these tests are simple to perform.

The IEEE 802.3u standard for 100Base-T specifies a physical-layer signaling scheme between two pieces of connected LAN equipment. A burst of Fast Link Pulses creates a link code word that describes the capabilities and fault status of the transmitting device as compared with the receiving device. By exchanging link code words, or auto-negotiating, a link is created based on the highest common mode of operation.

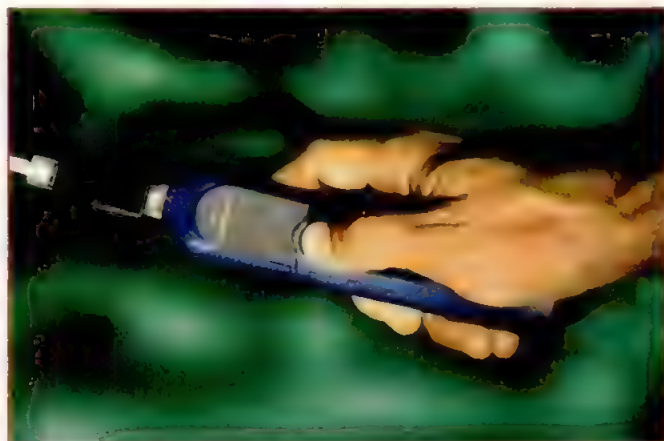
The LANMaster detects and decodes not only the Fast Link Pulses used in 100Base-T networks but also the Normal Link Pulses used in conventional

10Base-T equipment.

The device, which uses eight LEDs to display the results, can determine whether the equipment it is testing is capable of auto-negotiation. The LAN-

Master can also help troubleshoot the common wiring problem of a reversed pair: Even when link signals are present, the unit will indicate "no link" when the wires are reversed.

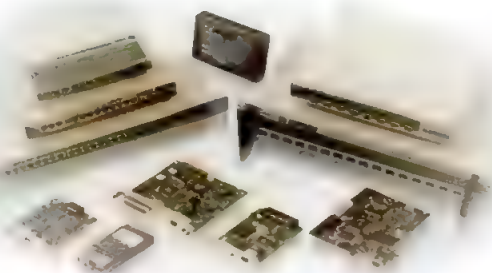
Psiber LANMaster 20. Street price: \$150. Psiber Data Systems Inc., San Diego; 619-571-9060; www.psiber.com. Choose 912 at www.pcmag.com/infolink.



IT'S ALIVE: The LANMaster 20 detects whether an Ethernet port has a 10- or 100-Mbps connection and whether it's running at half or full duplex.

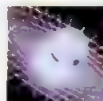
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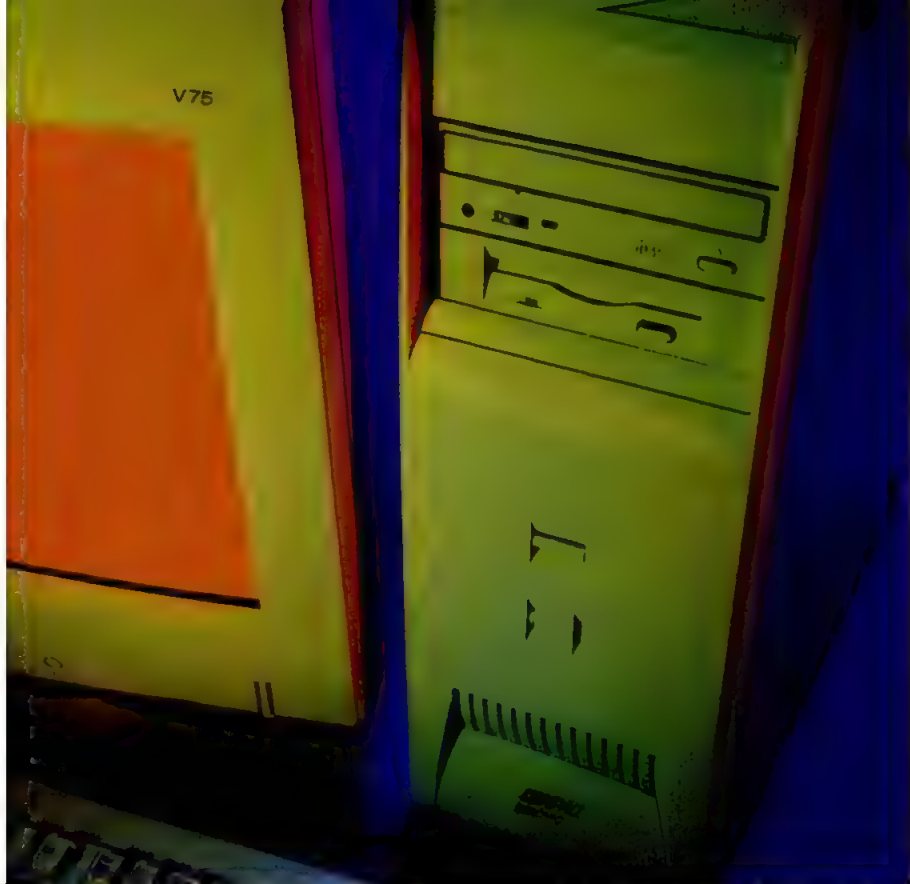
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Options for Armada 7000 family of notebook computers

- ArmadaStation Expansion Base: \$779¹
- ArmadaStation Tower Stand: \$99¹
- Compaq Briefcase: \$99¹

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PC Tech



Object-Based Web Design

Creating a standard browser-based document object model paves the way for programmatic control of page elements.

By William Robert Stanek

Anyone who has ever said that Web markup languages don't have the complexity of programming languages may have to adopt a whole new outlook. Object-based Web page design is here, and the face of Web publishing is changing rapidly. Soon just about everything you thought you knew will be a distant memory, and in its place will be a whole new way to publish on the Web.

Imagine creating Web pages where each element is an object that you can modify, move and delete. You'll have pages with images that dance across the page, multilevel tables that readers can mine for information, illustrations that come to life when the mouse pointer moves over them, and more. Sound far-fetched? It isn't.

Microsoft Internet Explorer (IE) and Netscape Naviga-

tor have supported dynamic content for some time now. What's new is that the latest versions support dynamic content through an extensible object model, called the *document object model*, which exposes the various elements in a Web page to scripting languages, such as JavaScript, and provides the necessary interfaces to script the behavior of these elements.

In this article, we'll take a look at the document object model. You'll learn how it works and how it may change the way we publish on the Web.

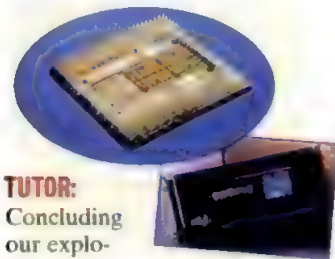
THE DOCUMENT OBJECT MODEL

In recent months, you've probably heard a lot about Dynamic HTML (HyperText Markup Language), which is implemented in Version 4.0 and later of IE and Navigator. With Dynamic HTML, you can create Web pages with

www.pcmag.com/pcstech

You'll find all of the articles, examples, and code files in this section at PC Tech Online.

INSIDE



TUTOR:

Concluding our exploration of microprocessors, we start this time with the Intel 486 and then work our way through the various flavors of the Pentium—touching on clones from AMD and Cyrix. We even consider the Mac's G3. *Page 307.*

UTILITIES: DecoMenu lets you customize your Windows 95 Start menu with a bitmap image of your choice, such as a company logo or an image that



represents a personal interest. The image becomes a bar that runs vertically along the left side of the menu. *Page 313.*

PC SOLUTIONS: Stopping Windows programs from starting up automatically—if they're in your StartUp folder; getting Navigator to be your default Web browser; using a single monitor with two computers; changing the owner's name in Windows 95; improved methods for expanded Excel charting sources; playing MIDI files in Microsoft Access; and more. *Page 347.*

special effects, animation, and other types of live updates without relying on a Web server to generate the necessary markup code for the updates. Compliant browsers reformat Web pages on the fly and automatically display changes. Users see the updates instantly and don't have to wait for the browser to reload a Web page or go back to the Web server for additional information.

Dynamic HTML achieves this level of flexibility and customizability using a document object model. The alternative to dynamic updates is to rely on the server to build a new page in response to specific events and requests. The drawbacks to such a solution are that the server must retransmit the data and users must wait for the new data. By eliminating the need to go back to the server for more information, you reduce the wait and make the Web a friendlier place to browse.

Although the document object models implemented in IE and Navigator are different, an effort is under way to create a standard document object model. The organization behind this effort is the World Wide Web Consortium (W3C). Like most Web technologies, the W3C document object model is being implemented incrementally, each new version introducing additional functionality. To get started, the W3C designated the combined functionality available in Version 3 of IE and Netscape Navigator as Level 0. All subsequent revisions of the document object model specification build on this base.

The Level 1 document object model specification is currently under development. While this version incorporates some of the functionality of both Microsoft's and Netscape's dynamic HTML, the specification does not attempt to implement fully all the

features of either version. Rather, the specification seeks to define a language-neutral interface for programming elements in HTML and XML (eXtensible Markup Language) pages.

As you probably know, HTML and XML are similar but serve different purposes. HTML is used to format text and multimedia. XML is used to structure data. To create a language-neutral interface

Like most Web technologies, the W3C document object model is being implemented incrementally.

for HTML and XML pages, the W3C document object model uses the Object Management Group's Interface Definition Language (IDL) to define a set of standard objects for representing HTML and XML documents and to define how this set of objects can be used to access and manipulate documents. For example, the specification defines a Document object that is a container for a Web page, its elements, and its contents. As such, Document is a parent object that represents the entire Web page and has child objects that represent the various components within the Web page.

Using IDL to define the object model is a brilliant step that allows Web pages to become much more than a set of standalone documents with links between them. With the object model, each Web page is an object that can interact with other compliant objects. Sets of these objects can work together to

become network-ready applications or a part of an extensive enterprise system. For example, you could use HTML to create the user interface for an application, a script in JavaScript to handle the interaction with the interface, and a Java program on the server to handle file processing. The HTML page, the script, and the Java program would be separate entities that work together, thanks to the document object model.

Users would see such an application as an area within a Web site with key entry points, such as a main application page. From this entry point, they could make selections and access other features within the application. Because each feature within the application is wrapped as an object, the application is completely extensible and could even be used to interface with other distributed objects. Of course, I'm getting a bit ahead of where the technology actually is today, but you can see the potential is enormous.

Currently, the document object model is used primarily to create pages that can be updated dynamically: You use HTML or XML to create a page's content and a programming or scripting language, such as Java or JavaScript, to provide the live update mechanism. Because the HTML or XML page is itself represented as an object, browsers can use the document object model to broker information between the page and other compliant objects—namely, scripts or programs.

THE KEY MODELS

The document object model Level 1 specification is broken down into three parts: core, XML, and HTML. The core document object model defines the core functionality of the specification. The basic, low-level objects are defined here. These objects can be used to represent and manipulate any type of struc-

```
interface HTMLImgElement : HTMLElement
{
    attribute boolean    isMap; // A Boolean value that determines if an image contains an image map.
    attribute wstring    useMap; // A String value that determines the name of the associated image map (if any).
    attribute wstring    border; // A String value that determines whether an image has a border and sets the width of
                                // the border if it is available.
    attribute long       vspace; // An Integer value that determines the vertical space around an image in pixels
    attribute long       hspace; // An Integer value that determines the horizontal space around an image in pixels
    attribute wstring    alt;    //A String value that determines the alternate text to associate with the image.
    attribute wstring    src;    // A String value that determines the source of the image as a URL
    attribute wstring    lowSrc; // A String value that determines the low-resolution source image to display
                                // before loading the image defined in the src attribute.
    attribute wstring    align; //A String value that determines the alignment of the image.
    attribute long       width; // An Integer value that determines the width of the image in pixels.
    attribute long       height; // An Integer value that determines the height of the image in pixels.
};
```

FIGURE 1: The IDL interface definition for HTMLImgElement.


```

<HTML>
<HEAD>
<TITLE>My Home Page</TITLE>
</HEAD>
<BODY>
<DIV ALIGN="CENTER">
<IMG SRC="new.gif" ALT="What's News" WIDTH=50
HEIGHT=45 BORDER=0 VSPACE=5 HSPACE=5>
<IMG SRC="main.gif" ALT="Main Attractions"
WIDTH=90 HEIGHT=45 BORDER=0 VSPACE=5 HSPACE=5>
<IMG SRC="help.gif" ALT="Learn More" WIDTH=50
HEIGHT=45 BORDER=0 VSPACE=5 HSPACE=5>
</DIV>
</BODY>
</HTML>

```

FIGURE 2: A sample HTML page.

tured document. However, the core model lacks the high-level objects necessary to manipulate specific types of documents conveniently; it also lacks advanced functions tailored to specific types of documents.

As you might expect, the high-level objects and functions are defined in the XML and HTML document object models. The XML model builds on the core model and adds objects that can be used to represent document type definitions, entities, and character data types. If you've worked with XML, you know that a document type definition (DTD) is an important part of an XML document, defining the elements used in the document. These elements can represent sets of tags, attributes for these tags, and other key aspects of the document. An application that processes the document can use the DTD to validate the document. (You can find more information in "Structuring Data with XML" in our issue of May 26.)

Providing the objects and interfaces necessary to represent a DTD in an XML document is a major step forward. Applications and XML processors can use these objects and interfaces to examine a document's DTD and to validate a document against its DTD. This functionality also paves the way for standard browsers, such as IE and Navigator, to be able to interpret XML documents.

Entities are another important part of XML documents. An entity is a component that can be dynamically inserted into a document when the document is processed. The component can be a text string or even a file to be substituted into the document. Using the XML interfaces for the document object model, an object could examine entity declarations in the DTD along with entity references in the body of the document.

Additionally, *character data*, or more specifically *parsed character data*, is a fundamental

component of an XML document. Character data refers to the actual text or raw data contained in a document. Thus an object could also examine the contents of a document using the XML interfaces for the document object model.

The HTML document object model also builds on the core model, adding objects that examine the various components of HTML documents. It includes objects and interfaces for examining meta information for documents, manipulating document elements, setting and getting the values of element attributes, and manipulating the content of elements.

If you examine these objects and interfaces, you'll see there's an enormous difference between the XML and HTML models reflecting their different functions. Because XML is used to define the structure of documents and has no predefined tags and attributes, the XML model doesn't need specific objects and interfaces for elements and attributes. In contrast, HTML does have predefined tags and attributes, and specific objects and interfaces for these elements and attributes are integral parts of the HTML model.

You'll find specific objects and interfaces for working with each major element in the HTML specification. Because the current HTML model is designed with HTML 4.0 in mind, the list of objects and interfaces is quite extensive, with interfaces for handling images, forms, tables, and embedded objects, and for basic elements such as paragraphs, table data cells, and a lot more.

These interfaces allow objects to modify and manipulate HTML elements. Objects can retrieve values for element attributes, such as the value of the ACTION attribute for an HTML form. Objects can change the values for element attributes dynamically, for example, changing the hypertext reference for a link based on a user preference. Objects can insert new elements into a document, perhaps inserting an input field into a form before or after an existing form element. And the list could go on and on.

INTERFACE DEFINITION LANGUAGE

The objects and interfaces for the document object model are defined completely in IDL. To understand the significance of using IDL interfaces, let's take a brief look at the origins of IDL and the ways it is used with the Common Object Request Broker Architec-

ture (CORBA) and the Internet Inter-ORB Protocol (IIOP). This brief introduction to CORBA and IIOP will also explain why IDL was used to provide the interface for the document object model in the first place. Before we dive in, it should be noted that although the document object model applies CORBA-related technologies, the use of these technologies doesn't mean Web pages have to use CORBA.

You've probably already heard of CORBA and IIOP because they are important technologies for enabling distributed computing. CORBA defines an architecture for communication among distributed objects, and IIOP uses this architecture to provide interoperability between heterogeneous distributed objects. In practice, CORBA and IIOP are used to replace traditional client/server applications with enterprise systems whose objects are distributed across multiple computers that can all communicate, regardless of the programming language, platform, or operating system.

The key component that makes this work is the Object Request Broker (ORB). The ORB helps distributed objects make and receive requests from other objects. When a request comes in, the ORB intercepts it and passes it off to the object that is supposed to handle it, then returns the results to the object that made the request. Because the ORB

```

HTMLimgElement instance 1
alt = "What's News";
border = "0";
height = 45;
hspace = 5;
src = "new.gif";
vspace = 5;
width = 50;

```

```

HTMLimgElement instance 2
alt = "Main Attractions";
border = "0";
height = 45;
hspace = 5;
src = "main.gif";
vspace = 5;
width = 90;

```

```

HTMLimgElement instance 3
alt = "Learn More";
border = "0";
height = 45;
hspace = 5;
src = "help.gif";
vspace = 5;
width = 90;

```

FIGURE 3: HTMLimgElement instances.

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Intercepts attachments before they are copied to your hard drive	YES	NO
Real-time scanning of incoming messages & attachments	YES	NO
Zero Administration Security (ZAS): Centralized installation, monitoring, and updating across the entire network	YES	NO
Installs for all profiles automatically	YES	NO
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Intercepts read & write operations in new and existing messages	YES	NO



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```
interface HTMLElement : Element
{
    attribute wstring      tagName; //A String value that identifies the element name
    attribute wstring      className; //A String value that identifies the element class
    attribute wstring      id; //A String value that identifies the id of the element
    attribute HTMLStyle    style; //A String value that identifies the style associated with the element
    attribute HTMLElement  parentElement; //A pointer to the parent element
    attribute wstring      title; //A String value that identifies the element title
    attribute wstring      lang; //A String value that identifies language
    attribute wstring      dir; //A String value that identifies the direction of text flow within the element

    void      addAttribute(in wstring name, in Object value, in long lFlags);
    Object    getAttribute(in wstring name, in long lFlags);
    boolean   removeAttribute(in wstring name, in long lFlags);
};
```

FIGURE 4: The *HTMLElement* interface definition in IDL.

handles requests transparently, the location of the object making the request doesn't matter. ORBs use IDL to declare the boundaries and interfaces of an object, then use these boundaries and interfaces to handle requests among objects. For example, when an ORB receives a request, the ORB uses the interface definition to determine which of an object's methods to invoke and to determine how parameters should be passed.

None of this would work without a set of rules for two-way communication, and as you might expect, ORBs can broker only information they can interpret, which means the information must be formatted in a specific way. Distributed objects format information for ORBs based on a set of language-specific bindings, which map language-specific calls and data to language-neutral calls and data. Languages providing CORBA bindings include C, C++, and Java.

The document object model implements a similar architecture. IDL is used to define the language-neutral interface for interaction among distributed objects, such as your Web page and a Java applet. Bindings to the document object model are used to map language-specific information to language-neutral information that can be passed from a Web page to a script or program and vice versa. Currently, document object model bindings are being developed primarily for Java and JavaScript, but they could be developed for other programming or scripting languages. Additionally, the necessary HTML and XML structures are assumed to be built into the browser or application that implements the document object model.

Here's the idea: A Java applet could use the Java bindings for the document object model to manipulate the contents of an HTML or XML page. In such a case, the browser module that implements the IDL interfaces would

have a role similar to an ORB and would broker the request between the Java applet and the Web page.

Keep in mind that requests generally are made as a result of some event occurring. *User-driven events* come from users' interaction with a Web page—for example, moving the pointer over an element in an HTML page. *Browser-driven events* are based on internal actions, such as when the browser finishes parsing the markup in a document. *Timed events* can occur randomly or at preset intervals, such as when a method makes a call every 10 seconds.

When a request is initiated, some type of event has occurred, and the browser module acting as an ORB can use an event handler or a similar mechanism to intercept the request. The browser module then uses the interface definitions to determine which object should handle the request and passes the request off to that object. In the final step, the results of the operation are passed back to the object that made the request—and that's only one side of the equation. The program can also initiate requests, which would be handled by the browser module acting in the role of an ORB. All this sounds complicated, I know. But it really does work.

IDL INTERFACE DEFINITIONS

The core, XML, and HTML object models have different sets of interface definitions. Each interface definition represents a related object in the object model. Because the interface definitions are written in IDL, they are language- and platform-neutral. That means the interfaces do not require specific operating systems, platforms, or programming languages. The only requirements are that the application implement the document object model and that objects accessing this model are programmed in a language that has bindings to

the document object model.

The objects within the document object model follow a specific tree-like structure. Flowing from the base of the object tree are objects called *nodes*. The root node for a document is the Document object, which has child nodes that represent the document's components. The child nodes include elements defined in a document, attributes of those elements, processing instructions within a document, comments within a document, and the actual text within a document.

To examine specific nodes, the document object model uses *iterator objects*, such as the *node iterator* and the *tree iterator*. The node iterator moves back and forth among nodes according to their positions, such as the next node or the *n*th node. The tree iterator, a subtype of the node iterator, moves to various nodes using the parent-child structure of the object tree. For example, the tree iterator can move to a parent node or to specific child and sibling nodes.

Like most object-based technologies, IDL objects can have associated methods, attributes (called properties in many other object models), and constants. Object methods perform specific functions, such as setting a value for an attribute of an HTML element. Constants and attributes, on the other hand, contain information about an object. Constants have fixed values, but you can manipulate the values of most attributes. Generally, object attributes correspond to like-named attributes for the associated HTML element.

To put this in perspective, consider how an IMG element is used with IDL. You create the IMG element when you use the tag in an HTML page. In IDL, the IMG element is implemented with the *HTMLImgElement* definition. This definition creates the interface for its associated object—the *HTMLImgElement* object, a high-level object that implements the



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```
public interface HTMLImgElement
extends HTMLElement {

    void setIsMap(boolean isMap);
    boolean getIsMap();

    void setUseMap(String useMap);
    String getUseMap();

    void setBorder(String border);
    String getBorder();

    void setVspace(long vspace);
    long getVspace();

    void setHspace(long hspace);
    long getHspace();

    void setAlt(String alt);
    String getAlt();

    void setSrc(String src);
    String getSrc();

    void setLowSrc(String lowSrc);
    String getLowSrc();

    void setAlign(String align);
    String getAlign();

    void setWidth(long width);
    long getWidth();

    void setHeight(long height);
    long getHeight();

};
```

FIGURE 5: The *HTMLImgElement* interface definition in Java.

HTMLElement interface and is defined as shown in Figure 1. I've added comments to make the purpose of each attribute clearer.

In reading this interface definition, you know how each specific attribute of the HTML IMG element is mapped out in IDL. Each attribute corresponds to a like-named attribute of the HTML IMG element. Armed with that knowledge, you can map an actual tag for a document to its corresponding HTMLImgElement definition.

Consider the case of the HTML page shown in Figure 2. The sample page has three image elements. When the document is represented in the document object model, there would be three HTMLImgElement objects, and the object instances would have values as shown in Figure 3. Note that the example does not take into account default values that may be set for some attributes.

By adding attributes or setting attribute values, you could dynamically change any of the images in the HTML page. When you do that, you are actually using the methods of the parent object HTMLElement. The interface definition for HTMLElement is shown as Example 4. Here again, I've added comments to make the purpose of each attribute clearer.

As you can see, the HTMLElement interface definition has attributes that correspond to many of the key attributes all HTML elements share, such as id, lang, dir, class, and style. The interface definition also makes it possible to read the event assignments. For this example, however, I've edited out those attributes as well as some general-purpose attributes. The Level 1 object model doesn't actually implement structures for handling events. Another feature missing from the Level 1 document object model is the ability to work with document style sheets. Structures for working with events and style sheets are planned for a later implementation.

The final definitions for the HTMLElement interface specify methods for working with attributes. When you change an element programmatically, these methods can be invoked to update the element. In this preliminary definition, there are three basic methods: addAttribute, getAttribute, and removeAttribute. The addAttribute method sets a value for a named attribute; getAttribute method returns a reference to a named attribute so that you can examine its values; and removeAttribute does just that, which effectively sets some attributes back to their default value.

LANGUAGE-SPECIFIC BINDINGS

The counterparts to IDL interface definitions are the language-specific bindings for the document object model, which map language-specific calls and data to language-neutral calls and data. The core, XML, and HTML object models have different sets of bindings. Because those bindings are language-specific, they must be implemented in each programming language separately. That means the bindings for Java are separate from the bindings for JavaScript.

For each interface implemented in IDL, there is a corresponding interface implemented in the language-specific bindings. To go back to the previous examples, the IDL interfaces HTMLElement and HTMLImgElement correspond to the Java interfaces of the same name. In Java, the interfaces implement structures that allow a Java program to manipulate elements and images dynamically.

Figure 5 shows the Java definition for the

HTMLImgElement interface. If you compare this definition with the its corresponding IDL definition, you'll see that the interfaces are strikingly similar. But where IDL interfaces often have associated methods and attributes, the language-specific interfaces may not. That is the case with Java, in which attributes are replaced with a pair of utility methods, one of which sets and the other gets the value of an attribute. For example, in Java, the utility methods used to set and get the value of an image's border are called setBorder and getBorder.

The use of any of the set/get methods is fairly straightforward once you know the mechanics. For example, to use setBorder, you invoke it with the new border value in the form of a string, such as:

```
setBorder("5");
Or
borderValue = "5";
setBorder(borderValue);
```

To use getBorder, you simply invoke it by name and assign the return value to a variable of the appropriate type, such as:

```
borderString = getBorder();
```

SUMMARY

In the coming months, you'll hear a lot about the document object model. Now that you know a bit about how IDL interfaces and the language-specific bindings are defined and used, you should be able to envision the process of passing information from a Web page to a program and vice versa using the document object model. As you see, getting information from a Web page to Java or JavaScript is a lot of work. Fortunately, once the document object model is implemented in your browser or application, you don't have to worry about the middleman anymore, which allows you to focus on implementing object-based solutions. You design your HTML or XML page to take advantage of the document object model, then define the structures to handle the necessary interactions and updates in your scripting or programming language of choice. **PC**

William Stanek is the creator of Central-Drive.Com and author of several books, including Learn the Internet in a Weekend and Increase Your Web Traffic in a Weekend, published by Prima Publishing. His latest book, Server-Side JavaScript: The Definitive Guide, will be published in June by O'Reilly & Associates. He can be contacted at netdesigns@tvpress.com.

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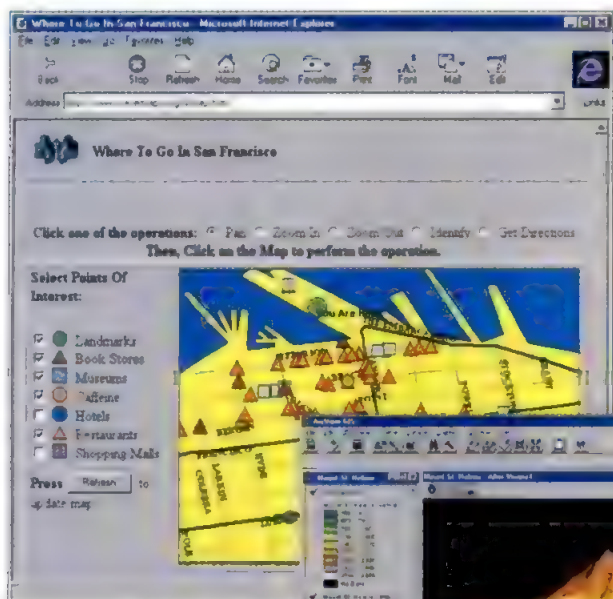
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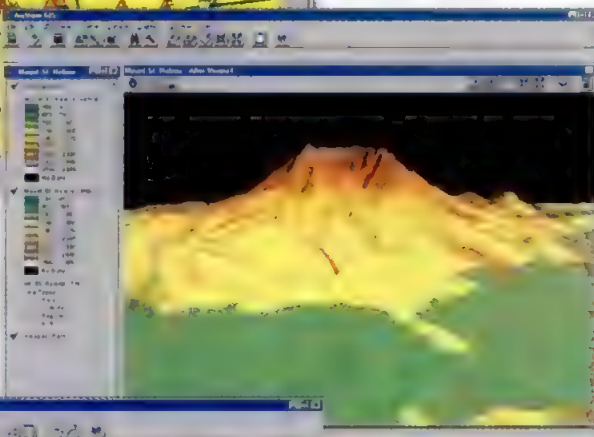
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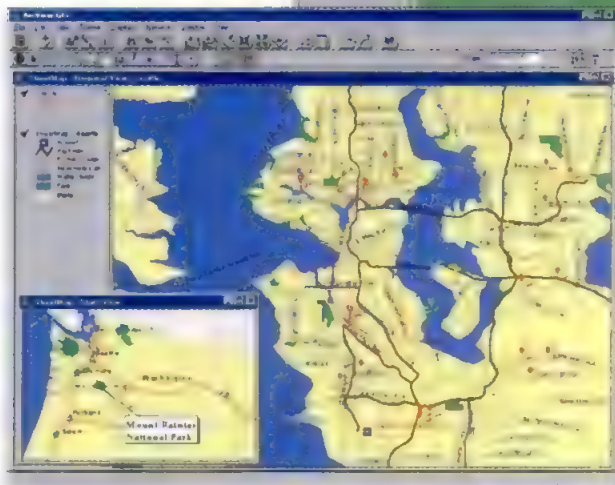
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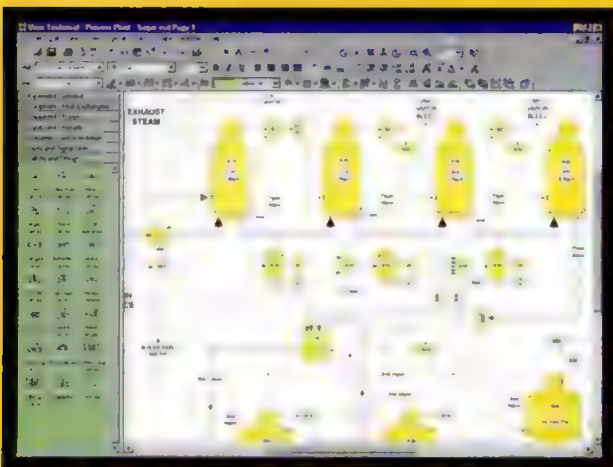
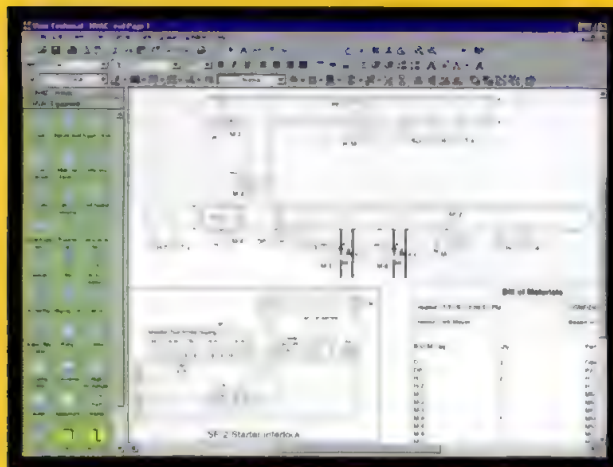
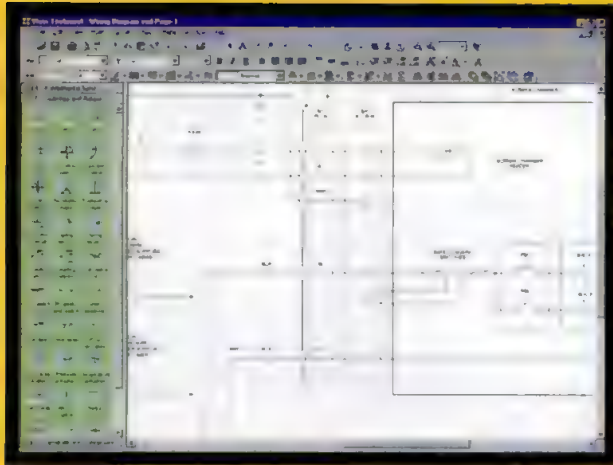
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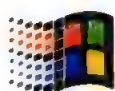
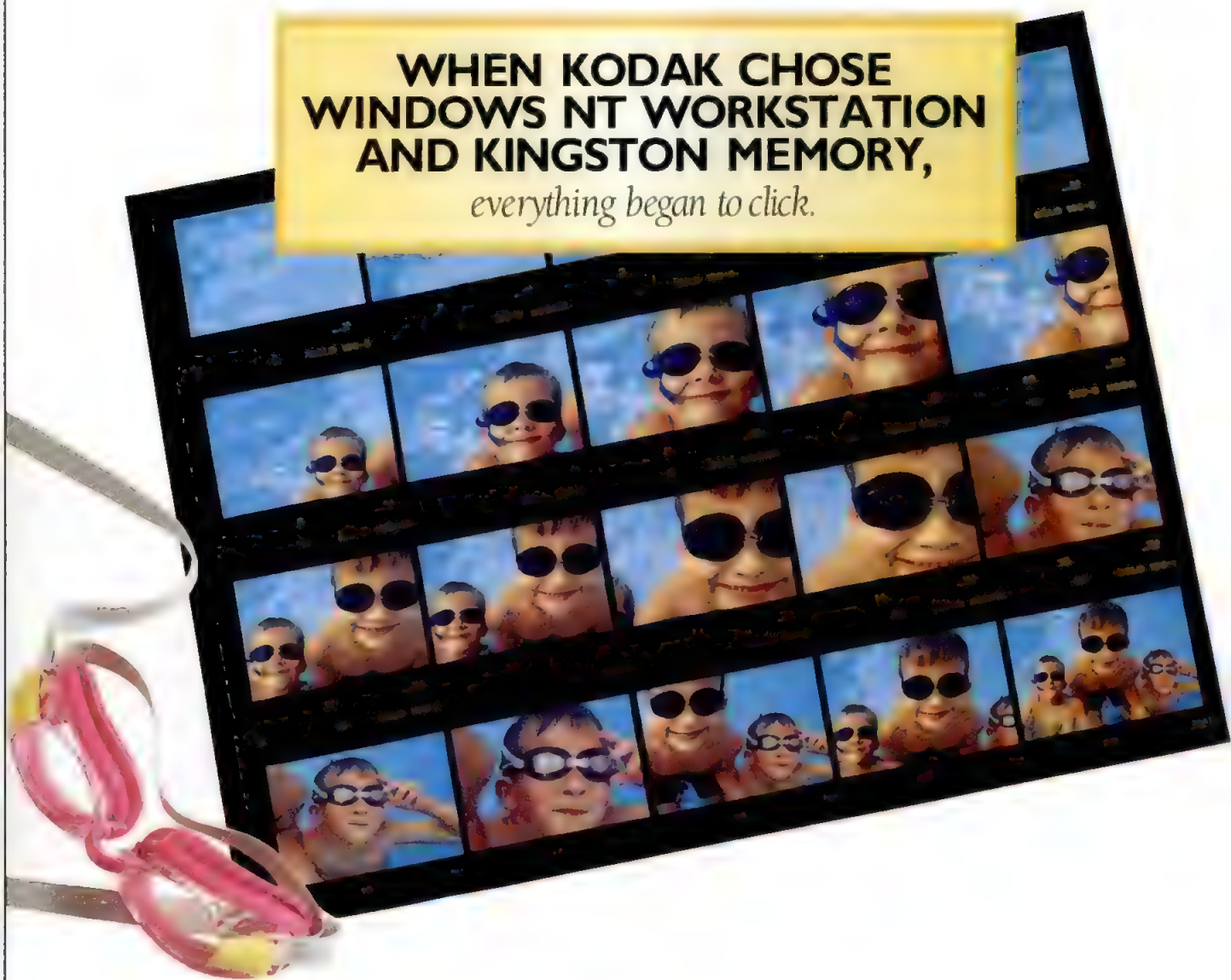


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The State of Processors

From Intel's 80486 to its Pentiums and on through the AMD K6, the Cyrix M II, and the PowerPC G3.

By Neil Randall

Over the past two Tutor columns, we've been looking at microprocessors—how they're made, how they work, and what technologies underlie their development. Last time, we began an overview of the major processor families, beginning (as you might have expected) with the Intel family. We left off with the 80386, and that brings us to its successor, the 80486. We'll go through the remainder of the Intel family as far as the Pentium II, touching on the Intel clones as well, and then we'll briefly examine the Motorola 680x0 and PowerPC families, which power the Macintosh.

THE INTEL 80486 FAMILY

Despite the importance of the 80386 family to the development of PCs, the PC platform as we know it today truly emerged with the introduction of the 486 in 1989. Windows 3.x could run reasonably well on the 80386DX and slowly but decently on the 80386SX, but the 486 brought into the mix a number of new technologies that resulted in faster and smoother performance.

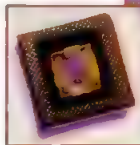
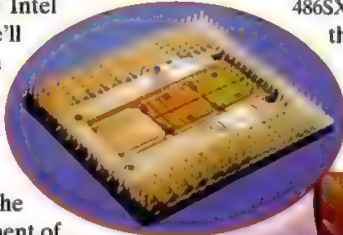
The 486 processor was the first in the Intel family to include a Level 1 cache (8K in size), which meant fewer RAM accesses, and since L1 was incorporated directly into the processor itself, access to the cached data was faster than ever before. The 486 was also the first Intel processor to offer burst mode, allowing increased data-transfer speeds between RAM and CPU. The 486 was the first truly pipelined Intel x86 processor, and thus it provided greater instruction throughput. It contained about 1.25 million transistors—five times as many as the 80386—which were dedicated to more advanced functional units, to an on-board floating-point unit (FPU), and to the on-board L1 cache. The FPU could perform calculations on real numbers—those containing decimal fractions—thus improving the performance of certain types of applications (scientific and graphics programs, in particular).

The 486DX was available in clock speeds of 25 MHz, 33 MHz, and 50 MHz. The chip ran cool enough that no heat sink was required, although some systems shipped with one anyway. The chip could address up to 4 gigabytes

of RAM, and like the 386, it ran in real, protected, and virtual 8086 modes.

Like the 80386, the 486 came in DX and SX versions. The cheaper SX version was available in 16-MHz, 20-MHz, 25-MHz, and 33-MHz clock speeds, but aside from the slower speeds and one other significant feature, it was practically identical to the 486DX. That one other feature was the lack of a math coprocessor. But even this wasn't actually true: The

486SX was simply a 486DX with the math coprocessor disabled. The DX/SX difference in the 486 family appears to have been little more than a marketing



THE LATEST PENTIUMS add (clockwise from lower left) multimedia extensions with MMX, a 1MB L2 cache in the Pentium Pro, and speeds up to 400 MHz with the Pentium II.

ploy: It was possible to upgrade the 486SX with floating-point capabilities by installing onto the motherboard a chip called the 80487SX, and the 80487SX was, in reality, an 80486DX. When installed, the chip disabled the original 486SX entirely. Strange but true.

Actually, the 487SX wasn't quite a 486DX: Its pin arrangement was different, to the extent that a 486DX proper could not fit into the 487SX slot on the (cheaper) 486SX motherboard. This pin arrangement allowed Intel to market another speed-up processor for the 486SX, the OverDrive chip. Introduced in 1992, the OverDrive chip fit into the slot for the 487SX; it came initially in a version for the 25-MHz 486SX and later in one for the 33-MHz 486SX. The idea was to double the clock speed of the SX original, and hence the chip came to be known as a *clock-doubling* chip. In the 25-MHz version, the chip maintained the 25-MHz speed when moving data from

sources external to the processor, but internal processes occurred at double that speed, 50 MHz. With the 33-MHz version, the internal speed was 66 MHz.

Clock doubling was such a popular idea that in the fall of 1992, Intel decided to release clock-doubled versions of the main DX processor itself, calling them the 80486DX2-50 and the 80486DX2-66. These chips did not supplement the standard 486DX, as the OverDrive chip added to the 486SX, but instead replaced it completely.

Then, in 1994, the company brought out the 80486DX4, which (despite its X4 appellation) ran at *triple* the DX's clock speed (*clock-tripling*). Here, external processes still operated at the speed of the bus (25 MHz or 33 MHz), but internal processes were now capable of speeds of 75 MHz (for the 25-MHz DX) and 100 MHz (for the 33-MHz version). These processors used a voltage of 3.3V in order to keep the heat down (the 5V DX2 required heat sinks for heat dissipation), and as a result, they typically required new motherboards.

AMD AND CYRIX ENTER THE FRAY

The 486 line of processors saw the first widely available clones, from other manufacturers. Both AMD (Advanced Micro Devices) and Cyrix made their own versions of the 486DX, but their products became better known with their 486DX2 clones, one copying the 486DX2-66 and another upping the ante to 80 MHz for internal speed. The 486DX2-80 was based on a 40-MHz system bus, and unlike the Intel DX2 chips (which ran hot at 5V) it ran at the cooler 3.3V. AMD and Cyrix both later introduced clock-tripled versions of their 40-MHz 486 processors, which ran at 120 MHz. Both AMD and Cyrix offered power management ("green") features beginning with their clock-doubled processors, but Intel didn't introduce these features until the DX4.

Although Intel stopped improving the 486 with the DX4-100, AMD and Cyrix kept going. In 1995, AMD offered the clock-quadrupled 5x86, a 33-MHz 486DX that ran internally at 133 MHz. AMD marketed the chip as comparable in performance to Intel's new Pentium/75, and thus the company called it the 5x86-75. But it was a 486DX in all respects, including the addition of the 16K Level 1 cache (the cache built into the processor), which Intel had introduced with the DX4. Cyrix followed suit with its own 5x86, called the M1sc, but this chip was much different from AMD's. In fact, the M1sc offered Pentium-like features, even though it was designed for use on 486 motherboards. Running at 100 MHz and 120 MHz, the chip included a 64-bit internal

bus, a six-stage pipeline (as opposed to the DX4's five-stage pipeline), and branch-prediction technology to improve the speed of instruction execution. It's important to remember, however, that the Cyrix 5x86 was introduced after Intel rolled out the Pentium, so these features were more useful in upgrading 486s than in pioneering new systems. For the purposes of this article, this chip provides a segue into the world of the Pentium.

THE MANY FLAVORS OF PENTIUM

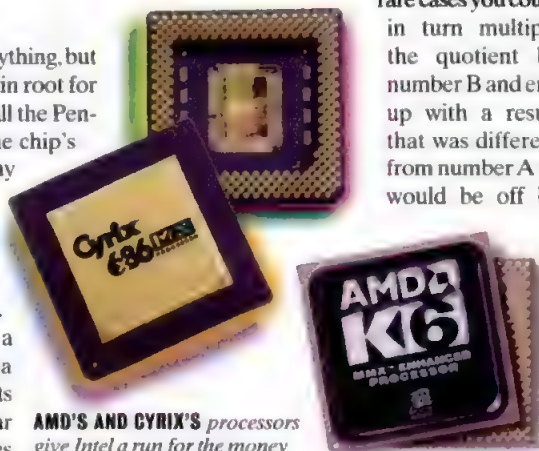
The word *pentium* doesn't mean anything, but it contains the syllable *pent*, the Latin root for *five*. Originally Intel was going to call the Pentium the 80586, in keeping with the chip's 80x86 predecessors. But the company didn't like the idea that AMD, Cyrix, and any other clone makers could use the name 80x86 as well, so Intel decided on a trademarkable name—hence Pentium. Although this new chip was still a CISC-based product, it incorporated a number of RISC technologies into its design, and it was the first superscalar Intel processor. These technologies allowed the chip to execute over 300

MIPS (million instructions per second) by contrast, the much slower DX2-66 executed less than 60 MIPS. The rating of MIPS is hardly an exact science, and the measure refers only to the processor's ability (not the I/O or other factors), but these ballpark figures demonstrate the magnitude of the speed increase.

The Pentium introduced other significant technologies. First, as mentioned, it offered a superscalar architecture: It used two pipelines rather than the 80486's single pipeline, although for best performance, programs had to be optimized so that the pipelines would work together. Second, it employed *branch-prediction* technology to help minimize the delays often incurred when a branch instruction alters the flow of instruction execution. Third, the Pentium increased the speed of data transfer from memory by using a 64-bit data bus instead of the 32-bit bus of the 80486. It sped transfer further by implementing pipeline-burst mode in both reading from and writing to memory, and by incorporating a 66-MHz memory bus (initially a 60-MHz bus); the 486 used a 33-MHz version. Fourth, the Pentium came with built-in power management. Fifth, two separate Level 1 caches—one for data and the other for instructions—allowed programs to be optimized fully in both categories, and a separate floating-point pipeline improved the speed of execution of floating-point instructions (those involving numbers with decimal places).

Perhaps ironically, it was the chip's built-in floating-point capabilities—or more specifically, its floating-point problems—that brought the chip to public awareness. Shortly after the Pentium's introduction, the media jumped on the news of a bug in the FDIV (*floating-point divide*) instruction. Essentially, if you divided number A by number B and the quotient contained a certain fraction (represented by the digits to the right of the decimal point), in some

rare cases you could in turn multiply the quotient by number B and end up with a result that was different from number A (it would be off by



AMD'S AND CYRIX'S processors give Intel a run for the money with innovations of their own.

256). Intel quickly offered replacements for the flawed chip, and in fact the company managed to turn the design flaw into a marketing bonanza. It was the first time a microprocessor had ever hit the big time as a news event. (See www.intel.com/procs/support/pentium/fdiv/index.htm to determine if your early Pentium has the FDIV bug.)

The Pentium debuted in March 1993 with the P/60 and the P/66 (as usual, the number represents the chip's speed in MHz), and all future Pentiums—right up to the P/200, introduced in mid-1996—were based on these two. The P/75, P/90, and P/100 used a clock multiplier of 1.5, the P/120 and P/133 clock-doubled the original versions, and the P/200 clock-tripled them. (The P/150 and P/166 used a 2.5 multiplier.) All versions contained over 3 million transistors, and all required heat sinks for heat dissipation.

Meanwhile, AMD and Cyrix capitalized on both the success of the Pentium and the chip's much-publicized FDIV flaw, introducing the 6x86 and the K5 respectively and marketing them as more reliable than the Pentium. Here, the two companies veered away from producing Intel clones and concentrated instead on original designs that, despite their originality, retained compatibility.

The 6x86—a CISC processor—offered two pipelines, each with seven stages, as opposed to the Pentium's five-stage, two-pipeline technology. It improved pipelining by offering the

results of instructions to both pipelines at once to reduce stalling, and by including better branch prediction and *out-of-order completion* (allowing instructions to be executed out of their coded order, as long as they don't rely on results from previous instructions).

The K5, on the other hand, was at the core a RISC processor that translated the x86 instruction set into simpler instructions. It contained six pipeline stages (instead of the Pentium's and 6x86's two), it decoupled decode and execute functions, it included six functional units (a branch unit, two load/store units, a floating-point unit, and two arithmetic logic units), and it included many advanced features similar to those of Cyrix's entry. One central difference was that the K5 was late to market and didn't hit its expected speed grades, and thus it failed to capture significant market share. AMD's follow-on K6 product, derived from its 1996 acquisition of NexGen, has been far more successful.

THE MMX EFFECTS

In 1997, Intel introduced the Pentium with MMX, a set of 57 additional instructions designed to improve the multimedia capabilities of the Pentium. These instructions focus on parallel execution and employ a technique called *single instruction, multiple data* (SIMD) to do their work. As the name suggests, SIMD allows a single instruction to work with more than one piece of data at the same time, thereby allowing the instruction to produce results more quickly. But this wasn't the only change in the MMX-adorned Pentiums. The pipeline increased to six stages from five, the two Level 1 caches were each increased from 8K to 16K, and branch prediction was improved.

THE PENTIUM PRO AND PENTIUM II

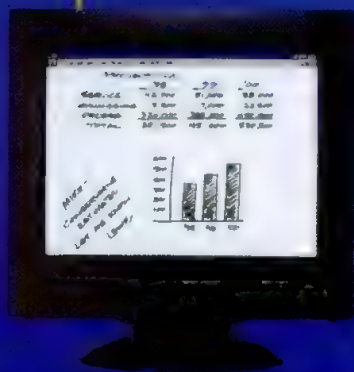
More than a year before the Pentium with MMX hit the market, Intel introduced its successor to the Pentium, the Pentium Pro. The Pentium Pro improved on the Pentium in several ways, and in the process it introduced a new way of executing instructions. The internal core is a RISC processor, and the x86 CISC instructions are built from RISC microinstructions, which are simpler and thus faster to execute (the combined microinstructions are called *RISC86 instructions*). The Pentium Pro increased the pipelining stages from 5 to 14, with three pipelines rather than two, to achieve significantly greater speed of execution. Furthermore, up to four Pentium Pros could operate simultaneously in a single system, double the multiprocessing capability of Pentium systems.

The Pentium Pro's 5.5 million transistors caused some heat concerns, but a reduction in



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the size of the transistors themselves helped keep this problem in check. Unfortunately (as *PC Magazine* was the first to discover), the Pentium Pro did not process certain 16-bit instructions efficiently, and thus it performed no better than a regular Pentium with similar clock speed on Windows 95 and performed worse on Windows 3.1.

One extremely significant change from the Pentium was including a built-in 256K Level 2 cache in addition to the earlier processor's 16K Level 1 caches—a feature that offered obvious speed improvements but, at the same time, greatly increased the cost of manufacturing a chip. This meant that the Pentium Pro never dropped in price to the extent that the Pentium did, and was in part the basis for developing the Pentium II.

In the Pentium II, Intel doubled the Level 1 caches to 32K but replaced the Pentium Pro's Level 2 cache with a larger, 512K cache with its own bus running at only half the speed of the Pentium II. The result was a cheaper processor but one technically not as fast as the Pentium Pro at the same clock speed. In practice, however, the Pentium II runs many of today's programs faster than does the Pentium Pro, because the clock speed itself has gone well beyond the Pro's 200 MHz—all the way to (at last count) 400 MHz—with a 100-MHz bus for the first time. You can expect to see a 450-MHz Pentium II later this year.

As you might expect, AMD and Cyrix worked hard to keep themselves in the picture. AMD released the K6 in 1997, offering a strong, low-cost competitor to the Pentium Pro, the Pentium MMX, and the Pentium II. Like the Pentium MMX, the K6 uses *dual voltage*, also called *split-rail voltage*, in which the processor's external voltage is higher than the internal voltage. Typically the former runs on 3.3V; the latter, with 0.25-micron chip designs, runs on as little as 2.2V. The K6 offers a L1 cache of 64K, the full range of MMX instructions, a large branch-prediction table (8,196 entries) and two levels of branch prediction, and seven parallel-execution units—more than any competing processor. Like the K5, it is highly compatible with Intel's designs. As of this writing, the K6 is available at speeds up to 300 MHz.

A bit later in 1997, Cyrix released the 6x86MX. The 6x86MX and its recent faster sibling, the M II, have a superscalar design, with two separate pipelines, 64K of L1 cache (like the K6), and multiple branch prediction (although the chips each have a branch-prediction table of only 512 entries). Unlike both the Pentium II and the K6, the M II does not have a RISC core; but since this has not hindered speed, it is not a significant issue. In addition to the L1 cache, the processor also features an

additional L1 cache of 256 bytes, designed to make the L1 cache itself more efficient. The M II is making significant inroads into the lower-priced PC market, although its performance at the 300-MHz level would suggest that it could fit the higher-end PC market as well.

MOTOROLA AND POWERPC

Here at *PC Magazine* we primarily cover machines with Intel or Intel-compatible processors running Microsoft operating systems, but there's more to computing than Wintel. Motorola processors have powered Apple's Macintosh since its inception, and SPARC processors have been at the core of Sun's Unix workstations and more. And these are just two of many processor families. Here, we'll look at the processors that have served as the guts of the Macintosh.

The original Macintosh, released in 1984, contained Motorola's 68000 processor. The processor (introduced in 1980) offered 32-bit computing internally, but it was slowed by its 16-bit data bus and a somewhat faster (24-bit) memory bus. The 68000 was a popular processor, powering not only the Macintosh but also the Commodore Amiga (originally the Amiga Lorraine) and the Atari ST, along with some early Unix workstations. It featured a two-stage pipeline and built-in expandability for floating-point operations. The floating-point capabilities weren't actually included until the introduction of the 68040 in late 1990, but the chip was clearly designed with the needs of the future in mind.

That future found its way through the 68010, 68020, 68030, 68040, 68050, and 68060. The 68010 offered support for virtual memory but otherwise remained much like the 68000. The 68020 provided the first major change, increasing the data and memory buses to 32 bits and thus becoming the first fully 32-bit 680x0 chip. It also offered a three-stage pipeline and a small (256-byte) data cache. Next up was the 68030, a 20-MHz processor that appeared in 1987. The 68030 provided separate caches for data and instructions, and it included a memory-mapping unit (MMU) directly on the chip. Three years later, the 68040 shipped with data and instruction caches of 4K each, a six-stage pipeline, and a Motorola 68881-compatible floating-point unit. The 68040 was the first Motorola chip built around the Harvard architecture, in which program and data buses are kept separate for faster execution.

In the past few years, the 680x0-based Macintoshes have been supplanted by those bearing PowerPC processors. Developed jointly by IBM and Motorola, the PowerPC is a RISC processor top to bottom. The first implemen-

tation, the PowerPC 601, allowed up to three instructions to be executed per clock cycle, and the chip offered 32-bit memory addressing and 52-bit virtual-memory addressing.

The PowerPC line continued through the 602, the 603 and 603e, the 604, the 620, and up to the 750 (more popularly known as the G3). Of course, the G3 is the best known of the PowerPC chips, because it is the star of a series of TV ads parodying the futuristic, song-and-dance Pentium MMX ads. In the G3 versions, the Pentium performers get toasted; Apple has centered much of its promotion around the fact that in testing, the G3 processors consistently garner stronger performance numbers than Pentium IIs of comparable or even higher speed. For example, the 266-MHz G3 tests faster in everything from floating-point operations through graphics performance than a similarly configured 300-MHz Pentium II or Pentium Pro. Part of this difference is owing to the G3's L1 cache size of 64K (versus the Pentium II's 32K), and much is also owing to the all-in-one design of G3-based systems, with all components (including a graphics component based on ATI's 3D Rage II) built onto the motherboard.

One of the most significant reasons for the high speed of the G3 is its inclusion of a *back-side cache*. The Pentium Pro has the L2 cache built into the processor chip; similarly, the G3 bypasses the system bus and uses a dedicated bus to handle L2 transactions, and the L2 cache is built right into the chip design. This method allows the processor to access the cache much more quickly than it could through the system bus. The result is a significant gain in the speed at which the Mac can execute instructions. But the RISC basis of the PowerPC can claim some of the credit as well, with the chip's simpler architecture leading to faster execution of processes. It remains to be seen whether the PowerPC will maintain this lead as Intel-based machines move into the next generation, but for now the difference is certainly real.

WRAPPING UP

The history of PC microprocessors demonstrates how technologies can be grafted onto other technologies in order to achieve improved performance and greater sophistication. But as fast as the changes have been, in the future these changes, if anything, will be even faster. Computer use will become more demanding, and the processor must bear the brunt of the demands. It is, after all, the heart of the whole thing. **PC**

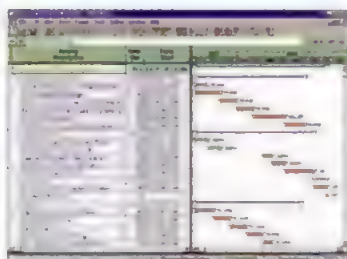
Neil Randall is the author of The Soul of the Internet (ITCP) and Special Edition Using Microsoft FrontPage98 (Que).

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COLORFUL PEOPLE FOR LEXMARK

Personalize Your Start Menu with DecoMenu

Now you can use a customized bitmap to decorate the Windows 95 or 98 Start menu.

By Neil J. Rubenking

Microsoft has branded the *Start* menu in all modern Windows platforms with a vertical stripe that reads, "Windows 95," "Windows 98," "Windows NT Workstation," and so on. DecoMenu lets you further decorate the *Start* menu with a bitmap of your own, replacing the six or seven icons for the main section of the *Start* menu, from *Programs* down to *Run...* Using DecoMenu, you can put the company logo on all company computers, or you can brand your home computer with a bitmap representing your favorite sport, pet, or hobby. Of course, DecoMenu can also restore the default *Start* menu icons.

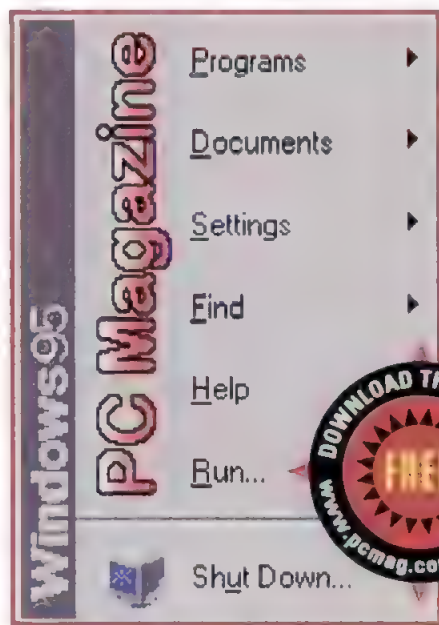
Actually, you can replace the *Start* menu icons without using DecoMenu, as explained in a User-to-User tip from *PC Magazine's* January 20, 1998, issue. The process described in the article involves devising a 32- by 192-pixel bitmap, using cut-and-paste to split it into six 32-by-32 bitmaps, registering these bitmaps as the six *Start* menu icons, and forcing Explorer to load the new icons rather than reading from the icon cache. Many readers wrote in asking for further help with this complex process, so I wrote DecoMenu!

You can obtain DecoMenu free by download from PC Magazine Online or by mail. Refer to the sidebar "How to Get the Files" for details. The Delphi 3 source code for DecoMenu is also provided for those interested in seeing how it works.

USING DECOMENU

DecoMenu is supplied as a self-contained install program. Run this program to install DecoMenu in the directory of your choice. The install program will add DecoMenu, its help

file, and an uninstall utility to your *Start* menu. DecoMenu supports Windows 95, Windows NT 4, Windows 98, and Windows NT 5. Note, though, that Windows 98 and Windows NT 5 are still in beta testing at the time of this writing. It's conceivable that DecoMenu may require minor changes to conform to the final-release versions of these two operating systems.



DECOMENU decorates the *Start* menu by replacing the main block of icons with a continuous bitmap.

DecoMenu's wizard-style interface walks you through the process of replacing or restoring the *Start* menu icons in a simple, step-by-step fashion, starting with an introduction. The Introduction page reports the active operating system and its version, as

detected by DecoMenu. This page also reports the values recorded in the system registry for the icon size and number of colors used for icons. In the unlikely event that your system's icon size is not set to 32-by-32 or 48-by-48, DecoMenu will not be able to build a personalized *Start* menu correctly. In that case, a warning panel will appear on the Introduction page, with a *Help* button that supplies instructions on how to correct the problem. But in most cases, this page is simply a starting point, and you'll quickly move on to the Questions page.

The Questions page lets DecoMenu obtain the information it needs to install or uninstall a new set of *Start* menu icons and display a preview of the changes. None of the 32-bit Windows platforms offer a way for programs to obtain the information automatically, so DecoMenu must ask you to provide the data. For help in answering any question, click the small question-mark button at the end of the question. DecoMenu saves your answers, so you won't have to enter them again unless you change your system configuration. The questions are listed below.

Is the Start menu using large icons? An option in the Taskbar Properties dialog, invoked by right-clicking the taskbar and choosing *Properties* from the pop-up menu, can cause the *Start* menu to use small (16-by-16) icons. If that option is set, you don't see the Windows version stripe at the far left of the *Start* menu and the icons are very small.

DecoMenu displays a simulated *Start* menu to verify your settings, and this display will not be correct unless the *Start* menu uses large icons. If you're going to use DecoMenu to personalize your *Start* menu, you must ensure that the *Start* menu uses large icons.

Are there gaps between the icons? On some 32-bit Windows platforms, the *Start* menu icons form a continuous area with no gaps. On other platforms, most notably Windows 95 with Internet Explorer 4 installed, there are gaps of about four pixels between the icons. DecoMenu needs to know whether the gaps are present in order to present an accurate preview.

For Programmers Only DecoMenu is a 32-bit Windows application written in Borland's visual programming tool, Delphi. It compiles under Delphi 3.0 or higher. The source code for DecoMenu is available on *PC Magazine's* Web site (www.pcmag.com/download) and demonstrates several programming techniques, including how to:

- alert the system to changes in shell icons;
- extract a bitmap from an external 32-bit EXE or DLL file;
- extract an image from an icon resource in a 32-bit EXE or DLL.

Support Help for *PC Magazine's* free utilities can be obtained in our online discussion areas, both on the World Wide Web (www.pcmag.com/discuss.htm) and on ZDNet in the Utilities section of ZDNet's Tips Forum (GO ZNT:TIPS). The authors of current utilities generally visit this forum daily. You may find an answer to your question simply by reading the messages posted in the forum. If the author is not available and the forum sysops can't answer your question, the Utilities column editor, who also checks this forum each day, will contact the author for you.

Is the "Favorites" item present? Some 32-bit Windows platforms include a *Start* menu item called *Favorites*. DecoMenu needs confirmation of its presence or absence in order to present an accurate preview.

Is the "Log Off" Start menu item present? The *Start* menu may include an item located above the *Shut Down* item whose name is *Log Off Xxxx*, where *Xxxx* is the user name of the current user. DecoMenu needs to know whether it's present in order to present an accurate preview.

Is the "Suspend" Start menu item present? On systems with advanced power management, this item may appear above the *Shut Down* item. DecoMenu needs to know whether it's present in order to present an accurate preview.

Are 48x48 Start menu icons enabled? *Start* menu icons of this size can be enabled under Windows 98, under Windows NT 5, or on systems with Microsoft Plus! installed. Even if the registry indicates the use of 48-by-48 icons, the *Start* menu will not be affected unless support for this feature is installed. Thus DecoMenu asks you to confirm the answer by checking the Display Properties dialog.

Are 256-color Start menu icons enabled? Such *Start* menu icons can be enabled under Windows 98, under Windows NT 5, or on systems with Microsoft Plus! installed. Here again, it's possible to set values in the registry indicating that icons can use 256 colors, but if support for 256-color icons isn't installed, the *Start* menu will not be affected.

When you've answered all the questions on this page, the *Next* button will be enabled. Click *Next* to proceed to the Confirmation page. On this page, DecoMenu will display a simulation of the *Start* menu, based on the answers from the Questions page. The simulation includes only the portion of the *Start* menu from the *Programs* item to the bottom. If you have changed the system colors or the font used for menu items, the simulation will reflect the actual values in use. Click on the actual *Start* menu and compare it with the simulation. The size and placement of all elements in the simulation should match the actual *Start* menu, though colors may differ slightly if the system is running in 256-color mode. If they don't match, you've probably given the wrong answer to one of the questions. Click the *Back* button to go back to the Questions page, then double-check your answers.

There is one situation in which the simulated *Start* menu icons won't quite match the real ones. DecoMenu can extract 48-by-48 icon images from any 32-bit EXE or DLL file, but if the icons are stored in 16-bit files, DecoMenu has to use 32-by-32 images and stretch them to 48-by-48. Few 16-bit files contain 48-by-48 icon images, but one of those few is the file containing the Microsoft enhanced system icons, called *Cool.dll*. These enhanced icons originated in the Microsoft Plus! Pack for Windows 95, but they may also be present in Windows 98 and Windows NT 5.

Occasionally DecoMenu encounters an icon that it can't load. This occurs when the file containing an icon is missing or corrupted or when a bitmap has been used in place of one

icons. This item will be enabled only if DecoMenu detects that the enhanced system icons are available and if they are not already in use. If this choice is selected, DecoMenu will install the enhanced system icons when you click *Next*.

Install the Windows default *Start* menu icons. This option tells DecoMenu that it should explicitly register the default values for the *Start* menu icons. The default icons are contained in *Shell32.dll*. This item is disabled if the standard *Start* menu icons are already explicitly registered.

Force defaults by clearing registration. If you choose this option, DecoMenu will delete the registry values that define the *Start* menu icons. This forces Windows to use the default

values. This item is disabled if the registry values for the *Start* menu icons have already been deleted.

After you select an action to take, the *Next* button will be enabled. If you chose to install enhanced, standard, or default icons, clicking *Next* will cause DecoMenu to perform the requested action immediately and then display the Finished page. If you chose to replace icons with a bitmap, the *Next* button will take you to the Preview page.

The Preview page will again show a simulation of the *Start* menu, but the main block of six or seven icons will initially be blanked out. This is where your custom bitmap will go. If you don't already have a bitmap of the correct size and color depth, don't worry! Click the *Blank* button and DecoMenu will create one for you, with the name *Temp.bmp*, in the same folder as DecoMenu itself.

It will then launch that bitmap for editing. After you have designed a bitmap, you can save the image with a new name. You can create as many bitmaps as you like.

Once you have an appropriate bitmap, click the *Choose* button to select it. If the bitmap is invalid or its size or color depth is incorrect, a red thumbs-down icon will flag the problem area. When you've selected an acceptable bitmap, you'll see green thumbs-up icons next to the items showing whether it is valid and what its size and color depth are, and the selected bitmap will be displayed on the simulated *Start* menu.

Depending on your answers back at the Questions page, the bitmap either will appear as a continuous strip or will be broken up into separate icon-size squares with gaps between them (see Figure 2). The *Transparent* check box affects the way DecoMenu

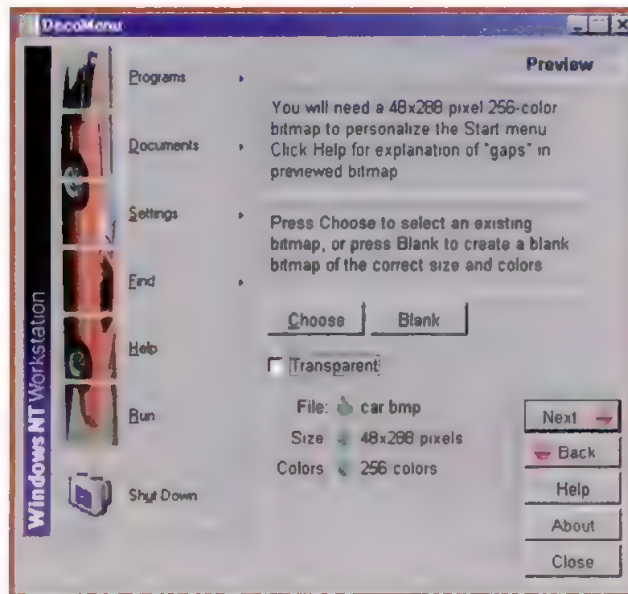


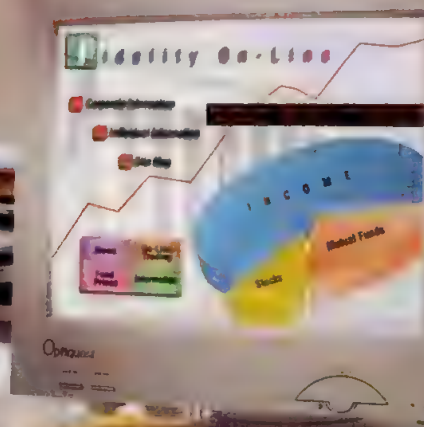
FIGURE 2: On certain platforms, the icons installed by DecoMenu do not form a continuous strip.

of the icons. If this occurs, the simulated *Start* menu will display three question marks in place of the problem icon. Don't worry about this, as DecoMenu will automatically fix the problem when you choose one of its four possible actions. Click the *Next* button to proceed to the Choices page, which contains four possible actions.

Replace the Start menu icons with a bitmap. This is the option that lets you create a custom decoration for your *Start* menu. Don't worry about not yet having a bitmap to use. On the next page, DecoMenu will help you to create a correctly sized bitmap or let you choose one that already exists. DecoMenu will then divide the bitmap into equal-size parts, transform each part into an icon, and register the icons with the system to represent the *Start* menu items.

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builds icons from the selected bitmap. If it is not checked, DecoMenu simply creates square 32-by-32 or 48-by-48 icons with no transparent area. But if it is checked, DecoMenu treats the color of the pixel in the bottom-left corner of the original bitmap as transparent. Every part of the image that matches that color will let the background show through. As you check and uncheck this box, the preview will change to match.

The *Next* button is enabled as soon as you've selected a valid bitmap. When you click it, DecoMenu goes to work behind the scenes. The utility splits the bitmap image into either six or seven parts and builds an icon from each part. The icons are named P1.ico through P6.ico or P7.ico, and they reside in the same folder as DecoMenu. DecoMenu registers these icons to represent the corresponding *Start* menu items and broadcasts a message to the system alerting it to the change. The system can take a few seconds to respond to this message. When the process is complete, you'll proceed to the Finished page.

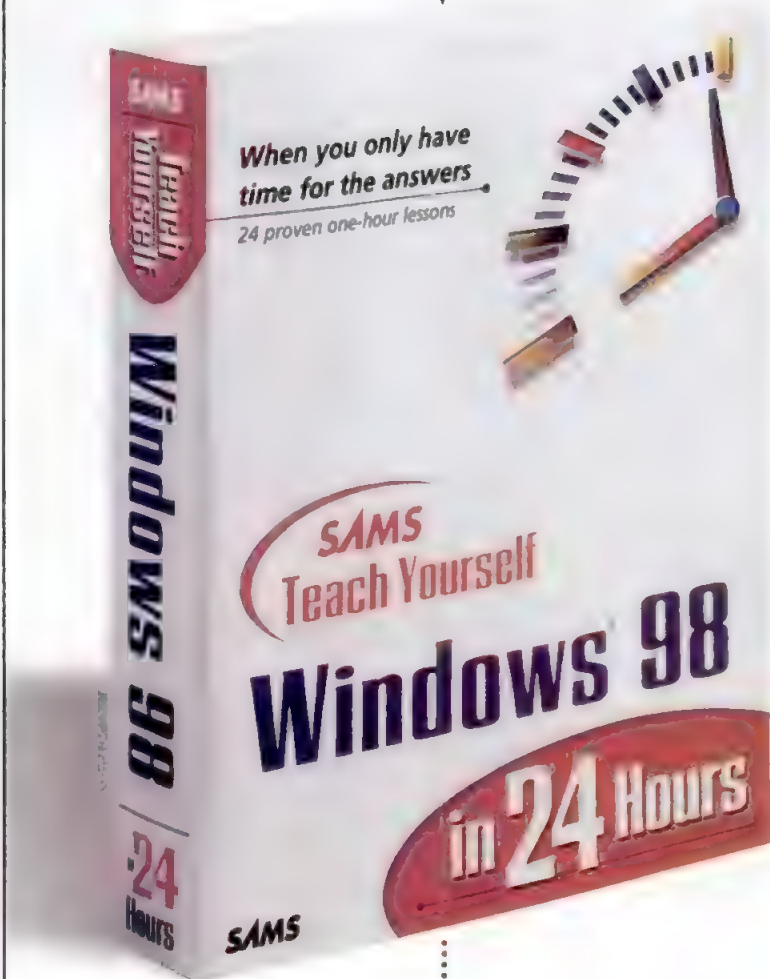
At this point, DecoMenu has completed the task you gave it. Click the *Start* menu button to examine the results. If you're pleased with the new look, click *Next* or *Close* to close DecoMenu. If not, use the *Back* button to redo any part of the process. One more thing: If your system has any IE 4-style toolbars on the taskbar, the toolbar icons may be randomized when DecoMenu notifies the system of its changes. This is easily fixed. Right-click the taskbar, choose *Properties*, and click *Auto hide*, changing it from checked to unchecked or vice versa. Now click *Apply*; click *Auto hide* again, restoring its original state; and click *OK*.

INSIDE DECOMENU

Changing a main *Start* menu icon or any of the standard shell icons is almost as simple as writing the desired icon location to the registry. Explorer caches the icons for speed, so DecoMenu needs to inform Explorer of the change. DecoMenu's biggest challenges came in the effort to present an accurate preview of the *Start* menu. The standard *ExtractIcon* API function returns an icon image that matches the current display settings. This is insufficient for DecoMenu, which needs to extract an icon image that matches a specified size and color depth. Also, to show the Windows stripe at the left of the menu properly, DecoMenu must extract that bitmap from Explorer itself.

To speed the display of system elements like the *Start* menu, Explorer caches the images for all shell icons in a hidden file called *ShellIconCache*. A change to the registry

Windows® 98



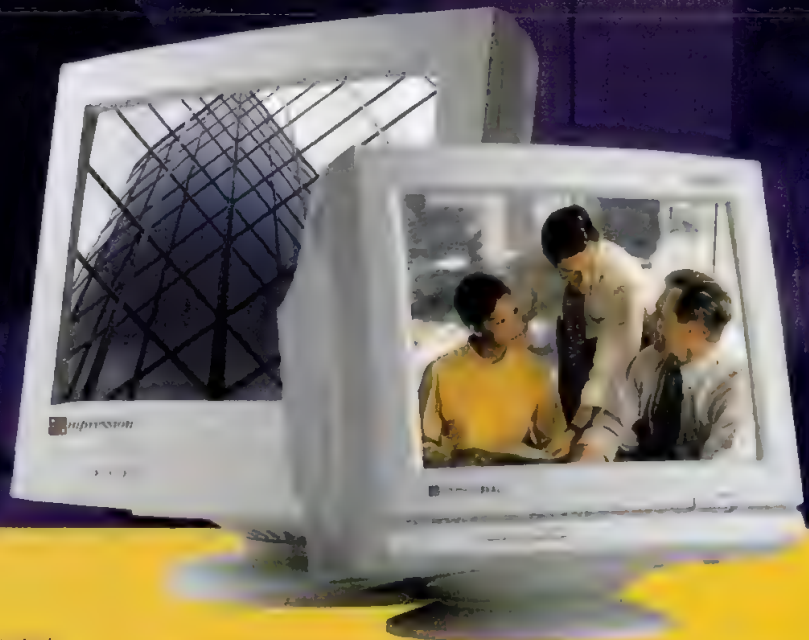
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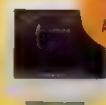
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entries that define the shell icons has no immediate effect, because Explorer continues to use the cached values. Deleting ShellIconCache within Windows has no effect either, because Explorer keeps the shell icons in memory while it's running and writes them out to ShellIconCache at shutdown. You can force Explorer to reread the icons by restarting in DOS mode and deleting ShellIconCache, but there's an easier way, illustrated by the EarthToExplorer procedure, found in the source module Decoshar.pas.

When the system's color depth or icon size changes, Explorer has to reread the shell icons, because the new properties might require it to use a different icon image. Setting a new color depth can require restarting Windows, so DecoMenu tweaks the icon size instead. After changing the registry values that define the System menu icons, DecoMenu reads the current icon size from the registry, writes it back one pixel larger, and broadcasts a WM_WININICHANGE message to make Explorer take note of the change. Then DecoMenu deletes the ShellIconCache file, writes the correct icon size back to the registry, and broadcasts another WM_WININICHANGE message.

The Win32 SDK's help for WM_WININICHANGE indicates that it is supported only under Windows NT and that under Windows 95, programs should use WM_SETTINGCHANGE instead. However, a closer look reveals that both messages are defined as having the same constant value, 26 (0x1A). The interpretation of the wParam and lParam values differs for the two messages, but DecoMenu passes constants for both of them. Interestingly enough, I found that when DecoMenu passed 0 for both wParam and lParam, Windows NT 5's Explorer didn't respond properly. Some system snooping revealed that when the display properties change, Explorer receives a WM_WININICHANGE message with 0x2A as its wParam and 0 as its lParam. Duplicating this message within DecoMenu solved the problem with Windows NT 5 and worked with the other platforms as well. As a result, regardless of which operating system is running, the message sends a wake-up call to Explorer and forces it to reread the shell icons.

EXTRACTING BITMAPS

DecoMenu's simulated Start menu displays the Windows platform name in a vertical stripe at the left edge, just like the real Start menu. This version stripe is stored as a bitmap resource within Explorer.exe, with resource ID number 157 or 161, depending on the Windows platform. It's a snap to load a bitmap that's stored as a resource in your own pro-

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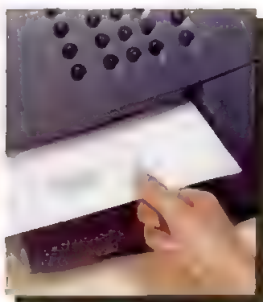
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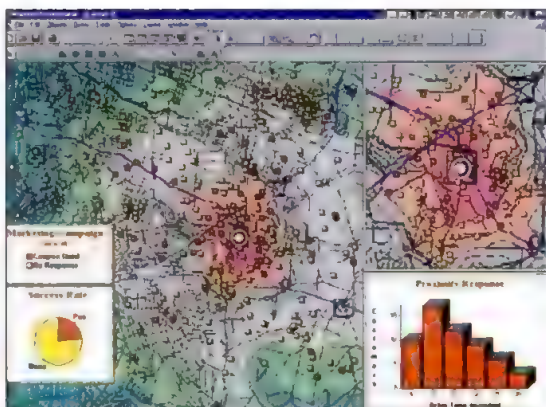
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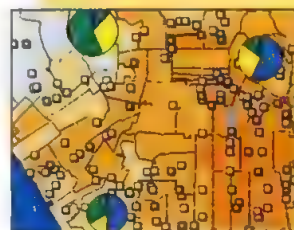
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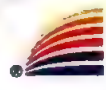
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gram. Loading one that resides in an external program or DLL file is a bit more involved.

The `XtractBitmap` function—defined in the unit `Decoshar.pas`—is a general-purpose function for extracting a bitmap from any 32-bit EXE or DLL file, based on the bitmap's name or numeric resource ID. It works well for the stripe bitmaps and for many others I have tested. However, because of the large and growing variety of formats for bitmap resources, it may not extract every possible variety of bitmap resource.

The first step is to load the EXE or DLL file as data, rather than loading the file for execution. A call to the `LoadLibraryEx` API function passing the `LOAD_LIBRARY_AS_DATA_FILE` flag yields a module handle for the loaded file. Next `XtractBitmap` uses the `FindResource` API function to get a resource handle for a bitmap resource matching the specified name or ID within the loaded file. Having located the resource, it calls the API functions `SizeOfResource` to get the resource's size and `LoadResource` to get a global handle to the resource. Passing the global handle to the API function `LockResource` finally yields an accessible pointer to the resource data.

A standard bitmap resource begins with a `BITMAPINFOHEADER` structure that defines the bitmap's height, width, color depth, and a number of other attributes. Unfortunately, the header does not include the offset of the array of values that define the bitmap's pixels. `XtractBitmap` attempts to deduce this offset from the information in the header, and it is usually successful. Passing this information to the API function `CreateDIBitmap` results in an ordinary bitmap handle. `XtractBitmap` uses this handle, along with the bitmap width and height, to initialize a `TBitmap` object that was passed by the calling function. After a bit of cleanup, the job is done.

One complicating factor is that the number of possible bitmap formats is increasing. There are two new header types in addition to the familiar `BITMAPINFOHEADER`: `BITMAPV4HEADER` is defined for use in Windows NT 4, and `BITMAPV5HEADER` goes with Windows NT 5

and Windows 98. Even when the ordinary `BITMAPINFOHEADER` is used, the bitmap may use RLE4 or RLE8 data compression. The header element that defines the size of the pixel array is optional in some cases. Some formats include palette information or a set of masks before the pixel array, and others place the pixel array immediately following the header. Also, the palette's size can vary. `XtractBitmap` attempts to calculate the correct location for the pixel array within the bitmap resource, but it may not work with all formats. For plain 16-color and 256-color bitmaps such as those used to store the Windows version stripe, it works fine.

EXTRACTING ICON IMAGES

In general, when you want to load an icon from an external file, you use the `ExtractIcon` API function. Icons can contain multiple images of varying sizes (usually 16, 32, or 48 and color depths (usually 2, 16, or 256 colors), but `ExtractIcon` always returns the image that's most appropriate for the current system settings. Unfortunately, that may not be what `DecoMenu` needs. For example, if the current color depth is 256 colors or greater but the system does not support 256-color *Start* menu icons, then the *Start* menu will use the 16-color images; but `ExtractIcon` will return 256-color images, and these may be visibly different from the 16-color images shown in the *Start* menu. If `DecoMenu` is to provide an accurate simulation of the *Start* menu, it needs to be able to extract one specific image of an icon, regardless of the system settings.

The `XtractIconImage` function, also defined in `Decoshar.pas`, does the job. Given the name of a 32-bit EXE or DLL file, the icon index, the desired dimension, and the desired bit count, it returns an icon handle for an image that precisely matches those parameters, or 0 if no such image is available. The process is very similar to what was used in `XtractBitmap` but is both more and less complex. It's more complex because in order to locate a specified icon image, it first must load the icon directory

resource and iterate through the list of images, and then it must load the image resource separately. It's less complex because once the resource information has been obtained, there's no difficulty in converting the data for use as an icon handle.

`XtractIconImage` loads the icon directory resource in much the same way that `XtractBitmap` loads the bitmap resource. The image directory resource consists of a 6-byte header that indicates the number of different images defined, followed by an `IconDirectoryEntry` for each image. Each image entry includes the dimensions and color depth of the image as well as the number of bytes in the image resource. In a multi-image ICO file, the last field is the offset of the image within the file. In an icon directory resource, however, that last field is the resource ID of the image resource.

Once `XtractIconImage` has an accessible pointer to the image directory resource, it steps through the array of image-entry data seeking the image whose icon size and color depth match the requested values. When a match is found, it examines the `dwImageOffset` field of the `IconDirectoryEntry` to get the resource ID for the icon image resource. It goes through the now-familiar routine of `FindResource`, `LoadResource`, and `LockResource` to get access to the image resource. Then it passes the resource data to the API function `CreateIconFromResource`, and it returns the resulting handle. If no image matches the requested size and color depth, it returns 0.

`DecoMenu` could have been an extremely simple utility: Just tweak the registry and alert Explorer to the change. However, giving it the ability to display a preview of the changed *Start* menu made it a much more useful and usable utility. That approach also made the project a lot more interesting from the programmer's point of view. **PC**

Neil J. Rubenking, the author of DecoMenu, is contributing technical editor of PC Magazine. Sheryl Canter is the editor of the Utilities column and a contributing editor of PC Magazine.

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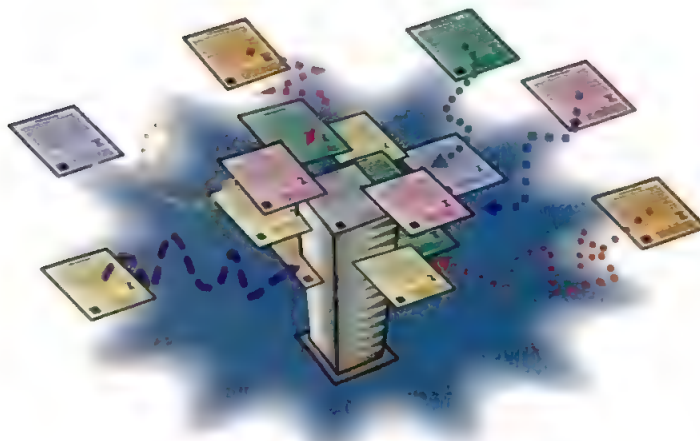


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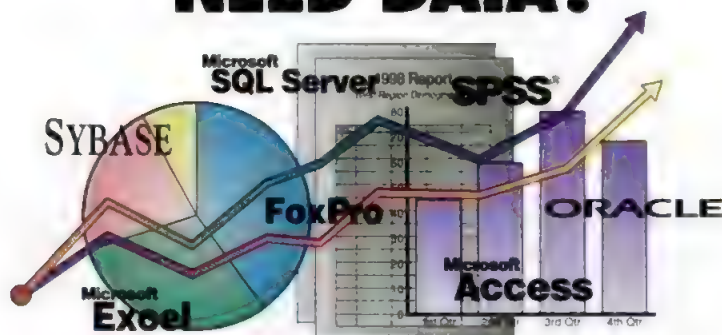
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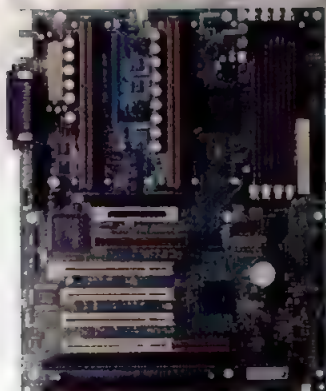


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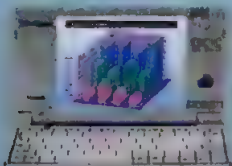
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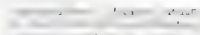
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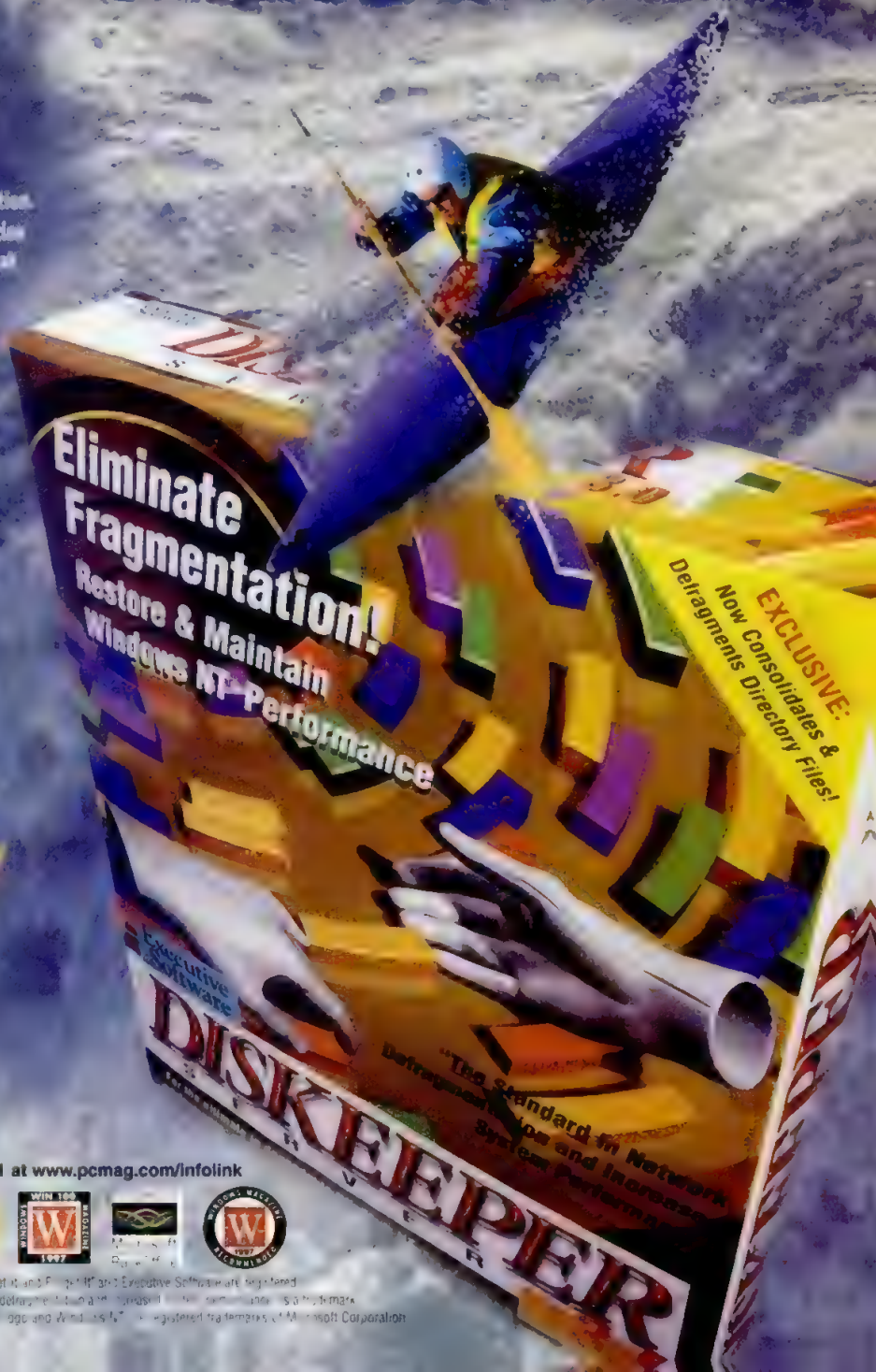
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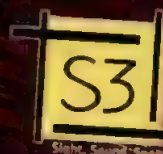
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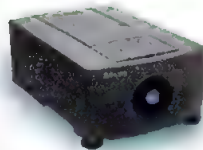
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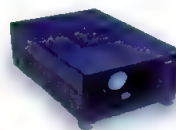
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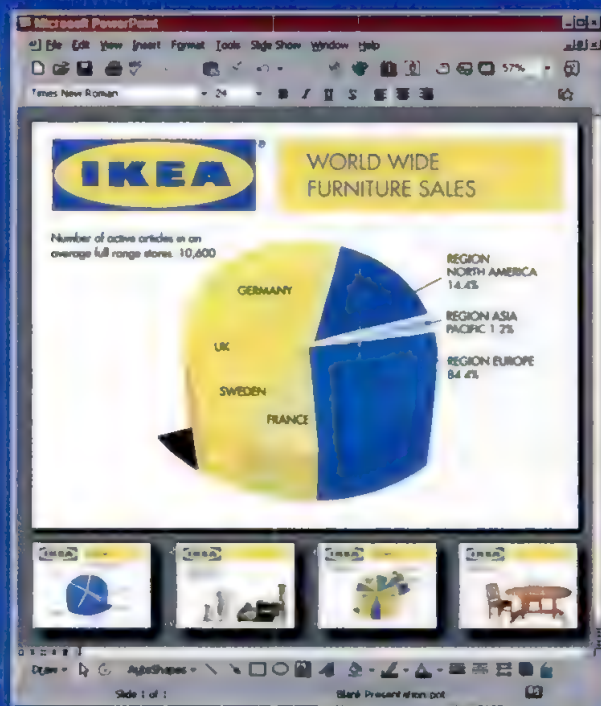
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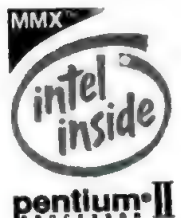
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User-to-User

BY NEIL J. RUBENKING

Controlling Auto-Starting Programs

Too often, installing a program adds unwanted items to your Startup folder. I'm not terribly fond of having a lot of programs start up automatically, especially if I was never consulted about it, so I have been either deleting the items from the Startup folder or moving them to another folder called NotStartup. (That way I can easily restore items if I happen to change my mind.)

Recently I created a folder under Startup called "not," and I drag any unwanted items from Startup to this subfolder. The applications in the "not" folder do not launch at start-up, but the folder does open. I can inspect it and manually start any program I might want for that session, then just close the folder. It also serves as a reminder of what I've disabled from starting automatically, in case I decide to restore an item.

GERALD GUTT
Fremont, California

PC MAGAZINE: To reorganize the items in your Start menu, right-click the Start button and choose *Explore*. You'll be presented with a standard Explorer window, opened in a folder with a name similar to C:\Windows\Start Menu or C:\Windows\Profiles\yourname\Start Menu (Figure 1). Double-click the Programs folder, which corresponds directly to the Programs submenu on the Start menu. In the resulting display, each folder icon corresponds to a submenu under the Programs menu, and each shortcut icon corresponds to a menu item that resides directly in the Programs menu.

To implement this reader's suggestion, locate and open the Startup folder. Now right-click anywhere in a vacant area of the right-hand pane and choose *New | Folder* from the pop-up menu, or select *New | Folder* from the File menu. Name the new folder "not," and

drag any unwanted shortcuts from the Startup folder into the new folder.

File Associations in Windows NT

There is a much safer and easier way to remove a previous file association than editing the registry directly in Windows NT. Simply use the Windows NT ASSOC command at a command prompt. Typing ASSOC with no parameters displays all currently defined associations. Typing ASSOC followed by an extension (including the initial period) displays the currently defined association for that extension. Adding an equal sign and a file-type name associates the extension with that file type. To remove an association, type ASSOC followed by the extension name and an equal sign—for example, ASSOC .WMF=.

BILL KRAENGEL
via the Internet

PC MAGAZINE: Readers frequently ask us how to correct file-association errors. Without knowing precisely how it happened, they may find that launching a BMP file brings up Notepad or that Windows attempts to load WRI files into Sound Recorder. Under Windows 95, there are a variety of ways to repair such errors, all the way up to editing the registry directly. Windows NT adds another tool in the form of ASSOC, an internal command handled by the command processor itself.

If you're running Windows NT, it's a good idea to use ASSOC right now to record all of your current file associations. Open a command prompt window and enter:

```
ASSOC > FILEASSOC.TXT
```

The resulting file will list all registered extensions and show the internal name of the file type associated with each. If you find that

a particular extension has gotten associated with the wrong file type, you can consult this list and restore the correct type.

It's important to refer to this list and use the file-type names reported by ASSOC, because they are generally not the same as the descriptive file-type

names displayed in Explorer. For example, ASSOC shows that the association for the extension .txt is "txtfile," while Explorer displays "Text Document." As far as Windows is concerned, the internal name is what matters; the descriptive name is used only for display.

How to Restore Navigator's Default Browser Query

When you start Netscape Navigator, the program checks whether it is the default browser. It asks to be the default when it is not, and users can choose to disable the check at that point. If, like me, you turn off the check to speed up the start-up process, you'll find there's no way to turn the check back on using Navigator's menus. This is especially frustrating if you installed another browser as the default and then find you can no longer choose Navigator as the default. To make Navigator your default browser again, you need to edit the Windows registry. Just go to HKEY_CURRENT_USER\Software\Netscape\Netscape Navigator\Main, then locate the string Ignore DefCheck and change the value to no.

When you restart Navigator, it will again be your default browser.

YEEMING JIH
via the Internet

PC MAGAZINE: This type of discardable dialog box is becoming more and more common in modern programs. There's almost never any indication of how to restore the dialog if you change your mind, and there's no standard technique for doing so. Before you check that fateful check box, consider carefully whether there's any chance you might need to bring back the dialog. If you've already discarded it and now want it back, you can try searching the program's help for a reference, or you can send a query to the company's tech-support department.

Users of Windows 95 or Windows NT 4 have experienced at least one of these discardable dialog boxes. By default, a Welcome dialog displays when either of these operating systems starts up. This dialog presents the user with a tip of the day, an option to view more tips, and a direct connection to the help system. Experienced users generally turn off the Welcome screen. To restore it, simply run the program Welcome.exe in the Windows directory. Check the box that says *Show this Welcome Screen...* and click *Close*. Each time you start Windows 95 or NT 4, the Welcome dialog will be displayed.

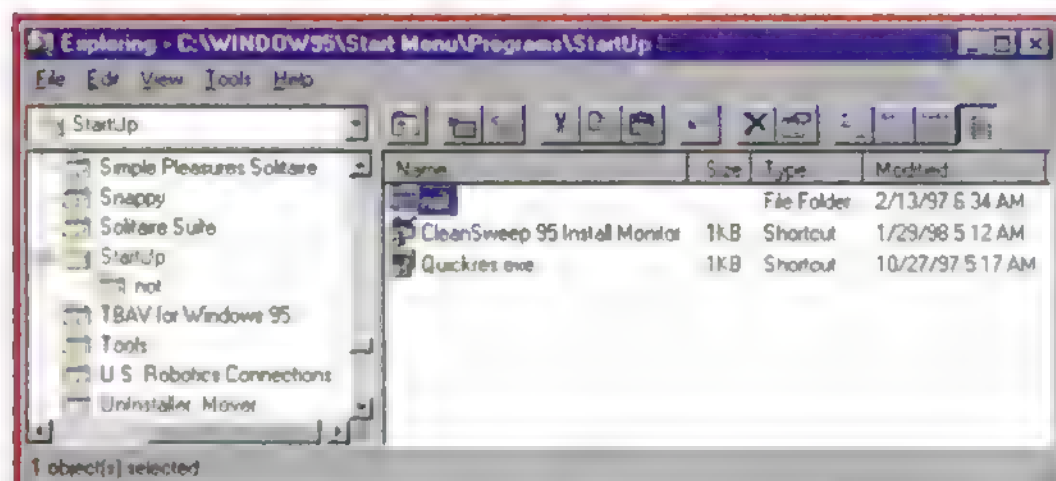


FIGURE 1: In this Explorer view of the Start menu, each folder corresponds to a submenu and each shortcut to a menu item.

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HARDWARE

Seeing Double?

I have two desktop computers but only one monitor. Is there any way that I can use my monitor with both systems without plugging it in and unplugging it every time I want to use the other system? I am planning to network these two computers eventually, but I'm not ready to do that yet, and I'd really like to avoid buying a second monitor at this point if I can.

LEON CASAUAY
via the Internet

PC MAGAZINE: There are many manual switch boxes available that will do exactly what you want. Plug both computer systems and the monitor into the box and you will be able to switch back and forth between the two systems. You can find such devices at a range of prices, starting at less than \$10 (though you'll also have to buy some additional cables).

You may want to set your sights a bit higher, however. If you're going to be switching back and forth between the two computers, you may want to get a switch box that also switches the keyboard connection. This would make it possible for you to have just one keyboard on your desk and switch it between systems along with the monitor. These cost only a few dollars more than the monitor-only models. Finally, there are some models starting at under \$20 that will also switch a mouse connection in addition to monitor and keyboard. The mouse connection does not always work reliably with all operating systems and ports, so you may want to check on this feature before you buy.

The investment in the switch box may continue to pay off even after you network the two systems together. If you're the only one who will be using the two computers and you don't need to view the images for both at the same time, a switch for the monitor and keyboard can give you a lot more desk space.

—Alfred Poor

The Case for a Case

I'm building a computer from components for the first time, and I have some questions about what case to use. I have already settled on a motherboard with an ATX form factor, but I don't know what to look for in a case. Will this motherboard fit in a mini-tower or midtower case? Will it fit in any case, or just those that are specified for ATX?

KEVIN FEEN
via the Internet

PC MAGAZINE: You will need to find a case that specifically can handle an ATX motherboard, though you should find a wide range of models from which to choose.

The ATX standard was established by Intel in 1995, with a revision (2.01) announced in early 1997. The design goal was to improve on the "Baby-AT" form factor, which was a more compact version of the original IBM AT layout. One problem with AT-style boards is that the CPU is typically located at the end of the expansion slots, so that the move to larger and hotter CPUs has meant that heat sinks and CPU-cooling fans often obstruct two or more expansion slots. The ATX design moves the CPU-mounting location alongside the expansion slots, leaving them unobstructed.

The ATX design also allows for a higher level of I/O integration on the motherboard. Instead of using up slots to mount ports for circuitry included on the motherboard, the ATX has a space that can hold two rows of I/O connectors for graphics, parallel and serial ports, sound, game controller, and even USB connectors.

An ATX motherboard also has a special power supply connector. The Baby-AT boards typically use two connectors, and it's not obvious which one goes where. In addition, there are two different types of connectors used with AT-style boards, so you have to get a power supply with matching connectors. The ATX standard uses a single connector, which is easier to plug into the motherboard without fear of reversing any connections.

You'll find that you have nearly as many case choices for ATX motherboards as for AT-style models, at prices that start under \$100. There are typical desktop models, mini-tower and midtower designs, and even the full-size towers and double-width units that give you plenty of room to add just about all the drives and other components that you could want. You can even find cases designed to fit in electronic-equipment racks that will accept ATX motherboards.—Alfred Poor

OPERATING ENVIRONMENTS

Allocating Disk Space

On a Novell server you can limit the size of a directory; that is, you can limit the space allocated to a directory. I am trying to set up a Windows 95 PC as an extra "server" on our network to give some users more file-storage space. I can create the directories easily enough, but I can't seem to configure their

sizes. I'd like to be able to limit the space allocated to each directory to 100MB. Do you know if there is any way to do this?

NORM HENRI
via the Internet

PC MAGAZINE: Unfortunately, Windows 95 provides no way to limit the size of a directory. If your aim is to allocate as much space as each user requires but not more than 100MB, you won't be able to do it under Windows 95. The closest you could come would be to write a program that monitored the disk space occupied by each user's files and warned you if one of them exceeded the limit.

But if you're willing to allocate a fixed amount of disk space to each user regardless of the amount of space actually used, there is a solution. Instead of a directory, give each user a compressed volume created with DriveSpace. The most common use of DriveSpace is to compress an entire drive, but you can also use it to create a compressed volume within a given drive. In DriveSpace 3, choose *Create Empty...* from the Advanced menu. In the resulting dialog, find the line that says, "The new drive will contain about __ MB of free space," and fill the blank with 100. Note

OUR ADVISORS

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233/MMX 32MB 2 1GB	1059.67
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HP VE 4 Series mini-towers

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HP VL 7 Series desktops

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233/Pii 32MB 3 2GB	1328.38
266/Pii 64MB 4 3GB 24X	1897.76
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266/Pii 64MB 6 4GB 24X	1997.75
333/Pii 64MB 6 4GB	2627.58

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200/MMX 32MB 4 3GB 32X	1049.87
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233/MMX 32MB 2GB	1267.44
233/MMX 32MB 3GB 24X	1267.25
233/MMX 32MB 4GB 24X	1317.85
266/Pii 32MB 4GB 24X	1358.75
300/Pii 32MB 4GB 24X	1539.37

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100CT 166/MMX 32MB 2GB 7.1" AM	2397.36

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4 1GB 12.1" DS 20X	
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4 1GB 12.1" AM 20X	2397.18
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1 34GB 12.1" DS 10X	1297.68
440CDT 133/MMX 16MB	
1 34GB 12.1" AM 10X	1637.89
460CDX 166/MMX 32MB	
2GB 12.1" DS 10X	1678.19
470CDT 200/MMX 32MB	
2 1GB 12.1" AM 10X	2387.56
480CDT 233/MMX 32MB	
3.8GB 12.1" AM 10X	2597.36
490CDT 233/MMX 32MB	
4GB 12.1" AM 20X	3387.36
490XCDT 266/Pii 32MB	
4GB 12.1" AM	3797.45

Tecra notebooks

520CDT 166/MMX 32MB	
3 8GB 12.1" AM 10X	2397.14
530CDT 166/MMX 32MB	
3 8GB 12.1" AM 10X	3087.52
550CDT 266/MMX 32MB 3.8GB 12.1" AM	3847.83
740CDT 166/MMX 16MB	
3GB 13.3" AM 10X	2637.86
740CDT 166/MMX 16MB	
3GB 13.3" AM 10X WIN NT	2827.36
750CDM 133/MMX 32MB	
4 77GB 13.3" AM 20X	4787.16
750DVD 233/MMX 64MB	
4 77GB 13.3" AM DVD	4987.80
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7164TE 266/MMX 32MB 4 1GB 13.3" AM	3767.26

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4220T 266/MMX 32MB 4GB 12.1" AM	3147.36
7710MT 150/MMX 16MB 1 6GB 12.1" AM	1487.36
7770DMT 233/MMX 32MB	
3GB 12.1" AM 20X	3437.29
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5GB 13.3" AM 20X	4387.36
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3000CTX 200/MMX 16MB 2 1GB 13.3" AM	2397.18
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12.1" AM 24X	2957.36
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Backup Exec for Windows NT V7.0 single-server edition	428.17
Backup Exec for Windows NT V7.0 enterprise edition	835.30
Backup Exec for NetWare V7.5 25-user single-server edition	307.58

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Hayes OPTIMA 56K	199.24
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Intel EtherExpress PRO/100 16-bit PC Card Enet/56K	309.44
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that the actual space used on the drive will be about 50MB. Repeat this process as many times as necessary, and assign each user one of the resulting drive letters.—Neil J. Rubenking

Correcting Windows 95 Registration Data

I recently purchased a slightly used computer. The machine works fine, but unfortunately, Windows 95 shows that the computer is "registered to" the previous owner. His name appears in the General System Properties screen, and occasionally it pops up as the default for some software that requires a name. How can I change the name of the person the computer is registered to, without reformatting my hard disk or reinstalling Windows 95?

GARY S. ELSNER
via the Internet

PC MAGAZINE: The registered owner and organization names for Windows 95 are stored in the Registry. Launch Regedit from the Start menu's *Run* command. Press Ctrl-F for *Find*. Enter *RegisteredOwner* in the *Find What* box, clear all the check boxes except *Values*, and press the *Find Next* button. In a moment, you should be looking at the *RegisteredOwner* value (in the right-hand pane) of the `HKEY_LOCAL_MACHINE\SOFTWARE\Microsoft\Windows\CurrentVersion` key. Just above it will be *RegisteredOrganization*. Double-click on either and make your corrections. Then close Regedit. Done!—Neil J. Rubenking

WORD PROCESSING

Inserting Printer Commands In Word

Word's Print field lets you insert printer commands to send to the printer directly, without the print driver trying to send them as text. Word's help file explains how to enter PostScript commands well enough. It also says that the feature works with Hewlett-Packard's PCL, but it doesn't explain how to enter the PCL commands, which use the character 1B hex (the Escape character). How can you insert this character into the Print field?

ANNA RICHARDSON
via ZDNet

PC MAGAZINE: You're absolutely right that the help for the *Print* field in Word (both Word 7 and Word 97) does a much better job of explaining how to use PostScript commands than how to use PCL commands. In particular, it leaves out this small but critical detail. Fortunately, the answer is simple.

The Escape character is 1B in hexadecimal, which translates to 27 in decimal. To add it to a *Print* field, simply type 27 without quotation marks. The sequence Esc E, for example, would translate to

27"E"

(with the text character surrounded by quotation marks), and the *Print* field would read

{print 27"E"}

If you aren't familiar with fields in Word, note that the open and close curly braces are not typed characters. Rather, they are field markers.

There are several ways to enter a field in Word, including the *Insert | Field* command, but the most straightforward (assuming you know the field name and options) is to enter it directly, as follows: Hit Ctrl-F9 to insert the field markers, and leave the cursor between them. You can then type the text of the field itself. With most fields, you would then hit F9 to let the field calculate results, but with the *Print* field, there's nothing to calculate. The field simply passes the commands to the printer.

If you're wondering why anyone would use the *Print* field, then you probably don't need it. One of this field's primary functions is to let you print the overlays stored in some printers.

In general, PCL-compatible printers let you store things like a signature, a letterhead, a company logo, or an electronic version of a form. The *Print* field lets you embed a command in a document to tell the printer to use a specific overlay with that document. For printers that are fully PCL 5-compatible, the command to print an overlay on every page, for example, is Esc&f#y4X, with # representing the stored overlay's ID number. (To turn off the overlay, substitute 5X for 4X.) If the ID number is 12, the command is Esc&f12y4X, and the *Print* field reads: {print 27"&f12y4X"}.

Finally, note that the *Print* field does not work correctly in the original version of Word 97 when it's running in Windows NT 4.0. If you're running Windows NT, you'll want to upgrade to Word's Service Release 1, better known as SR-1.—M. David Stone

SPREADSHEETS

Better Ways to Get an Expandable-Chart Source

With regard to the expandable-chart solution published in your issue of February 24, 1998, the idea of using an INDEX function seems unnecessarily complex. Here's a simpler way to

keep your Excel chart up-to-date:

1. Create the data series you want to chart.
2. Use the chart wizard to create your chart.
3. Click anywhere within the plot area, other than on a gridline. Excel draws a blue border around the source data.
4. Click on the handle at the lower-right corner of the blue border, and drag the range downward to include one blank row.
5. Whenever you need to add a new set of values to be charted, click into the blank row, then choose *Insert | Rows*.
6. Type your data into the inserted row.

The data series for the chart will be extended automatically each time you insert a new row. All you have to do is repeat steps 5 and 6 for each new row. The only downside to this solution is that your chart reflects one row of blank data.

KEVIN ROQUEMORE
Carrollton, Texas

I'm sure you'll get many other ways to auto-expand the selection for charts. Here's the approach that I've used for years:

=A\$1:INDEX(A\$1:A\$50,COUNT
 (A\$1:A\$50))

Obviously, this would be for data in A1:A50. The chart will reflect only cells that are not blank. This approach is fairly simple and involves no database.

MIKE CHAPUT
Woodland Park, Colorado

PC MAGAZINE: Thanks to all the readers who sent in alternative ideas for making charts stay automatically in sync with expanding data ranges. Most suggestions involved the blank-row technique described by Kevin Roquemore—a technique, incidentally, that works in all spreadsheet programs, not just Excel. As Mr. Roquemore says, this approach has only one drawback—the blank data point that appears at the right side of each data series. The more data points you have, though, the less significant that empty point becomes. So, particularly with large charts that are updated frequently, the blank-row approach is an excellent alternative.

Steps 3 and 4 in Mr. Roquemore's recipe apply to Excel 97. In earlier versions, where the blue box around the source data does not appear, you can simply select the source data plus a blank row before you begin creating the chart.

Note that including a blank row or column at the edge of a range and then inserting new rows or columns within is a good way to keep any range reference current. For example, suppose you have data in A1:A100, with a

PCTech Ask Our Advisors

Option Compare Database
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```
Declare Function mciExecute Lib "winmm.dll" (ByVal lpstrCommand As String)  
As Long
```

```
Public Function PlayMidi()  
Dim strMidiFile As String, lngRet As Long, x As Long  
Dim strOpenCommandString As String  
Dim strErrorString As String
```

```
strErrorString = Space(255)  
strMidiFile = InputBox("Enter the name of the .MID file:", "Play MIDI  
File", _  
"C:\Windows\Media\Passport.Mid")  
If Trim(strMidiFile) = "" Then Exit Function  
strOpenCommandString = "open " & Trim(strMidiFile) & "  
type sequencer alias midfile"
```

```
lngRet = mciExecute(strOpenCommandString)  
lngRet = mciExecute("play midfile wait")  
lngRet = mciExecute("close midfile")
```

```
End Function
```



FIGURE 1: The code shown here demonstrates use of the `mciExecute` Windows API function to play a MIDI file from VBA.

total cell below, and you expect to be adding more data as time goes on. If you put your SUM formula in A102 and make it reference A1:A101 (A101 being blank), you can subsequently insert a new row above the blank row and the formula will automatically adjust to incorporate that new row.

Mr. Chaput's INDEX formula has an advantage over my INDEX formula in not requiring subsequent data to be entered via the *Data Form* command. You can make the referenced range (A1:A50 in his example) arbitrarily large without affecting the appearance of the chart. If your data eventually overflows that range, you have only one formula, with two range references, to update.

—Craig Stinson

DATABASES

Playing MIDI Files in Microsoft Access

What function can I use to play MIDI files in Microsoft Access, and could you please provide sample code?

MOHAMED HABIB
via the Internet

PC MAGAZINE: To play a MIDI file in Access, you send a series of commands to the Windows media-control interface (MCI). The

usual sequence goes like this: First you open the file or device, then you play the file, then you close the file or device. The simplest way to do this is with the MCI command-string interface, which accepts simple text-string commands. To play a MIDI file named `Midfile.mid`, for example, the command strings you'd send to the MCI would be

```
Open midfile.mid type sequencer  
alias midfile  
Play midfile wait  
Close midfile
```

The type sequencer specifies the MIDI sequencer, which is the appropriate device for MIDI files. The `alias midfile` creates an alias that you can use to identify the file in future commands. The `wait` option on the `Play` command tells the MCI to return control to your application only when the command completes, or in this case, when the MIDI file is finished playing.

`Open`, `Play`, and `Close` are three of the approximately 45 valid MCI command strings. The easiest way to send these strings in VBA is to use the `mciExecute` Win32 API call. Figure 1 shows a sample function that requests the name of a MIDI file and then plays that file using `mciExecute`. The `mciExecute` function accepts a single argument, the MCI command string, and then does several things. First, it

sends the command string to the MCI. Then it checks to see whether an error has occurred. If one has, it obtains the appropriate error-message text and displays a dialog box reporting the error.

If you want some control over error handling yourself, you can use two other API functions instead: `mciSendString` and `mciGetErrorString`. A code example that demonstrates these functions is available from PC Magazine Online. The `mciSendString` API accepts four arguments. The first is the MCI command string. The second is a string to hold information returned by the MCI, for those commands that request information. When the string isn't needed, the argument can be 0. The third argument specifies the length of the string passed in argument two. The fourth and final argument is either 0 or the handle of a callback window to which Windows sends a notification message when the requested MCI command completes. This can be used with the `Notify` option to find out when an MCI command completes, provided you have some way of detecting the message when it arrives. Unfortunately, the version of VBA that's included with Office 97 has no built-in way to detect Windows messages. You can do this, however, using an ActiveX control such as The Redmond Consulting Group's Message Blaster. The trial version can be downloaded from www.trcg.com.

For more information on the MCI API calls and the media-control interface, see the Microsoft Platform SDK (the successor to the Win32 SDK). The SDK is available at www.microsoft.com/msdn/sdk/. You can download the code mentioned here from PC Magazine Online. Go to www.pcmag.com/download and choose the archive file for this issue.—Sal Ricciardi

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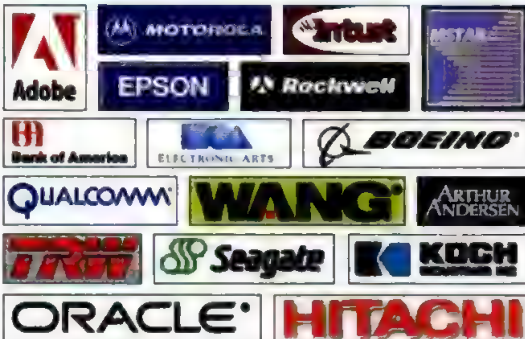
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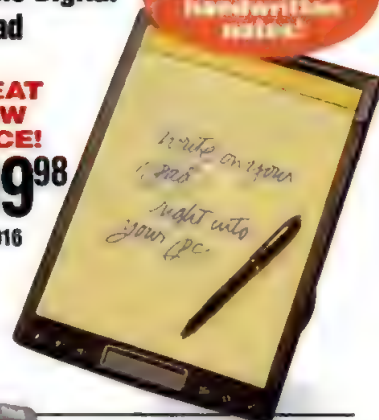
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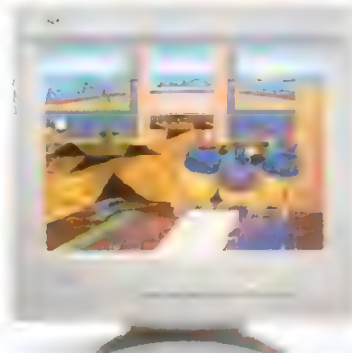
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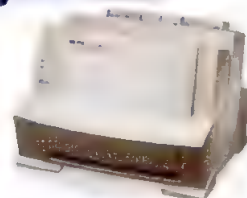
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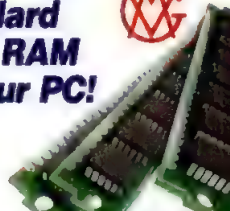


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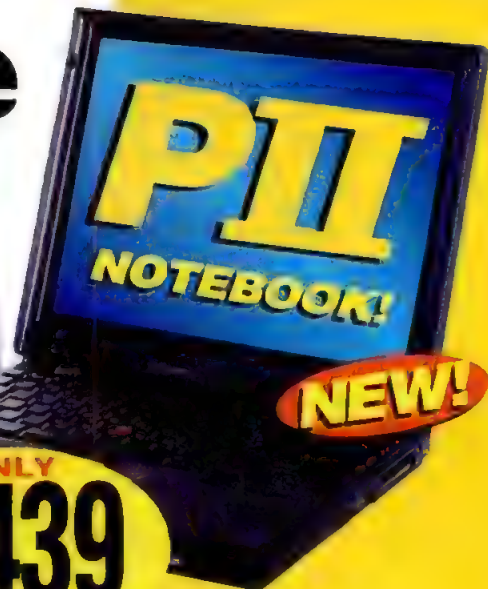
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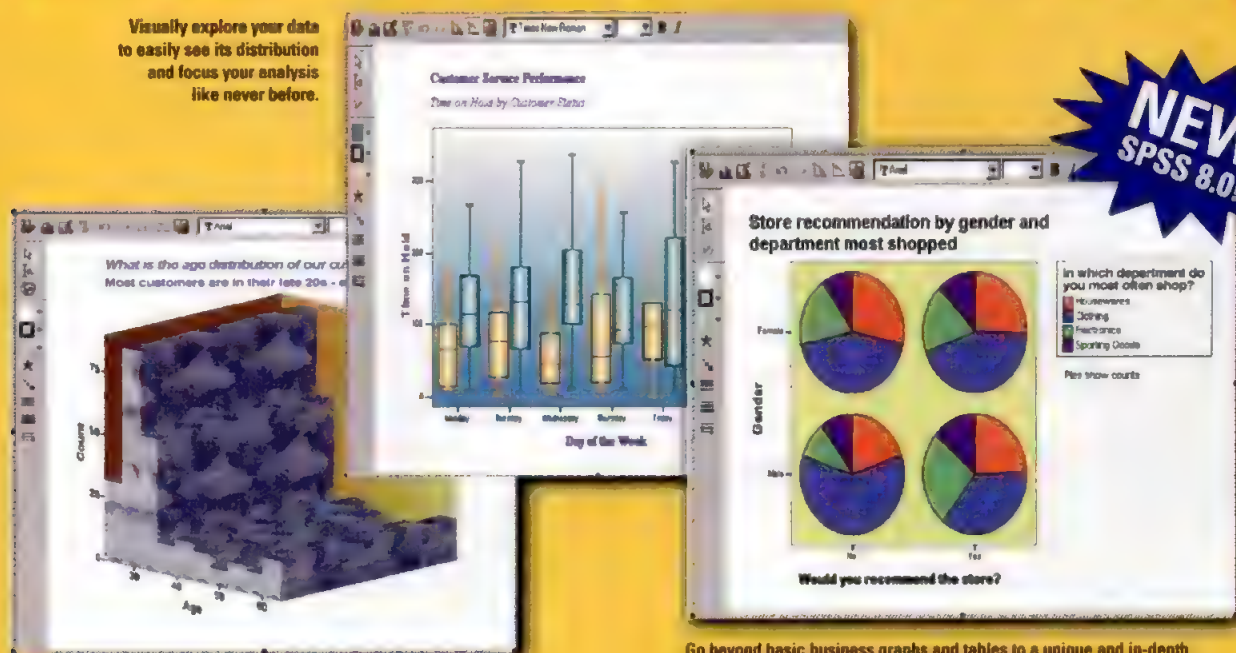
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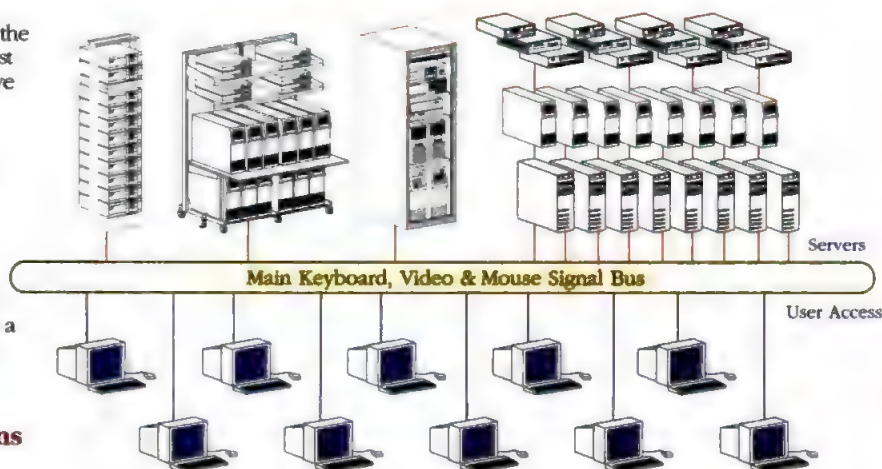
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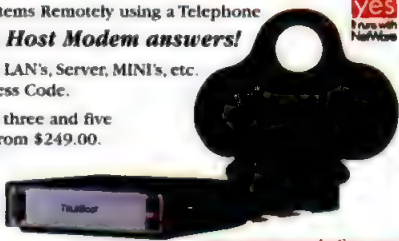
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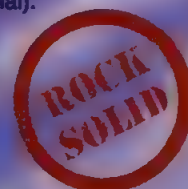
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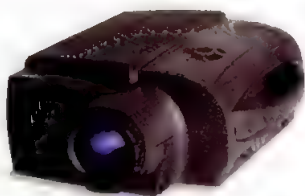
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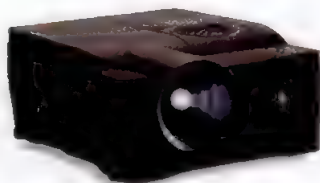


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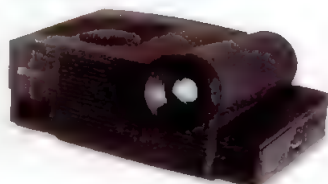


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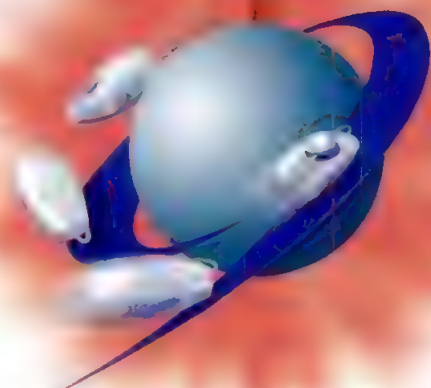
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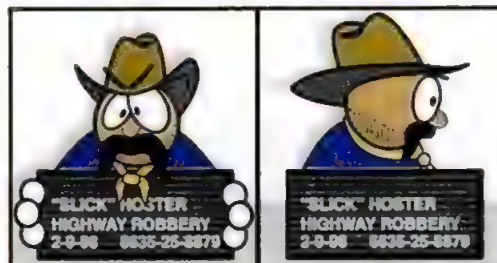
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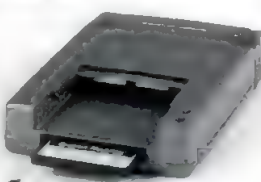
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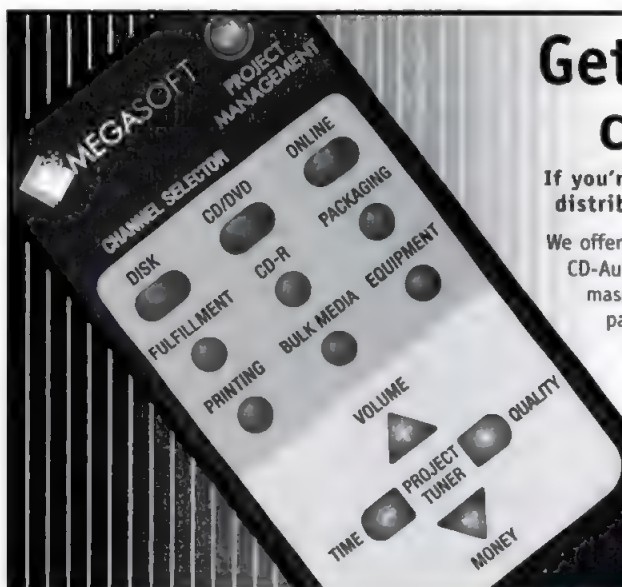
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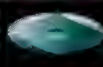
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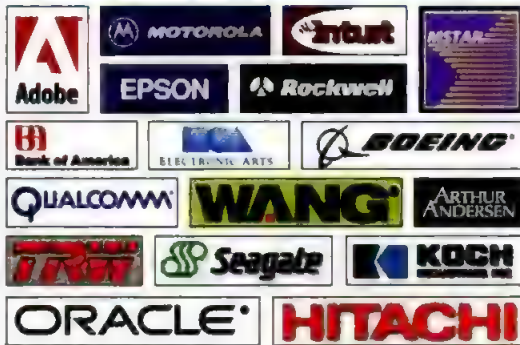
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After Hours

Fretwork 101

Guitar instruction software offers sound advice for players at any level.

By Jake Kirchner

Millions of people in this country play the guitar, and every single one of them would like to play better. Although there's no substitute for a good teacher and regular practice, a little computer time can speed up any student's progress.

A generation of raised-in-the-sixties Dylan and Clapton wanna-bes are discovering a renewed love for the guitar, while yet another wave of teenagers is kindling a passion for this most versatile of instruments. Into this natural market for guitar instruction have rushed a number of software companies, offering CD-ROMs for players of every skill level and every musical taste: rock, classical, jazz, and blues.

For this roundup, we reviewed nine packages targeting novices to intermediate players. We put the products to the test using *PC Magazine* staff members at the beginner, intermediate, and advanced levels of guitar-playing ability.

Guitropolis

Guitropolis is the first effort of Alfred Interactive, the new media division of venerable music instruction company Alfred Publishing. The program is set up in the form of an adventure game with high-quality graphics and videos. The

where you meet "crazy characters, explore unique locations and play challenging puzzles and games" unfortunately hides its guitar instruction behind hard-to-navigate scenes and nonintuitive interfaces. What any of this has to do with



presentation is stunning, but unfortunately, the instruction is not. Guitropolis is likely to engender a reaction of equal parts fascination and frustration.

Directed to beginning guitarists, Guitropolis promises to "transport [you] to another world—one where you'll enter a guitar novice and exit a legend!" This "whimsical city,"

learning to play the guitar is nowhere made obvious, and a first-time student will quickly tire of the game, while gaining little musical proficiency.

Guitropolis redeems itself as a teaching tool by including the method-only versions of the Alfred Basic Guitar Method and Teach Yourself to Play Guitar. Although the method-only material suffers from uninspired stop-action video of fret board fingering and makes limited use of multimedia, the ground-up teaching approach of the Alfred method does provide sound instruction.

Bottom line: Novice players will do well to avoid the noisy and bizarre alien shoot-'em-up games with musical themes of the Guitropolis portion of the disk and

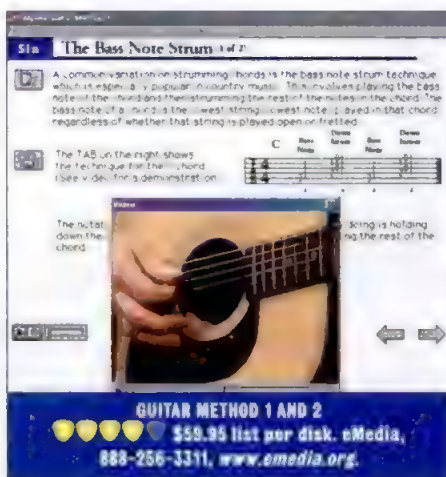
start working their way through the method-only portion. But even as an entry-level instruction disk, Guitropolis does not stack up very well against some of its competitors.

Guitar Method 1 and 2

The company e-Media has spread its basic guitar instruction over two CDs, each priced at \$60 (street). The total course of instruction may be pricey compared to the single-disk approach of others, but no beginning player will complain about the content or thoroughness of the eMedia approach.

You don't need to buy both lessons, but the first disk will take you only so far. The most rudimentary barre chords are not introduced until the second disk, for instance. Guitar Method 1 starts with the basics: how to hold a guitar, string it, and tune it. But the program quickly has you playing simple songs based on the instruction of each section.

The first disk, recently updated, contains more than 60 different lessons and includes more than 100 songs. Many are rather simple folk standards, ranging from "Aura Lee" to "Yankee Doodle"; rock tunes



INSIDE

QUICK CLIPS

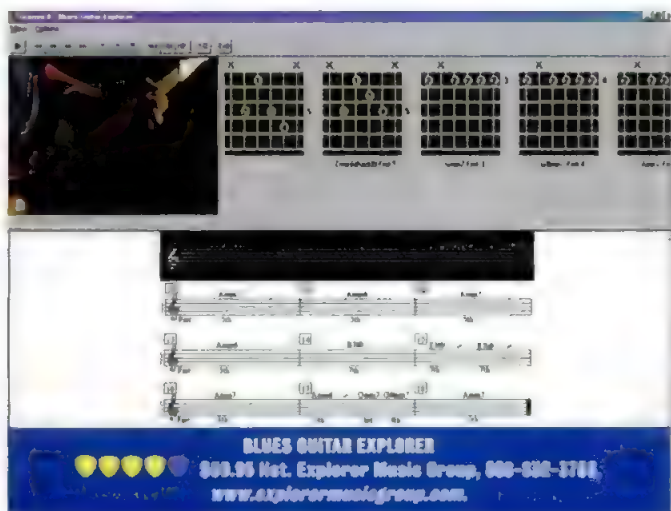
Sneak a peek at six new titles, from SimSafari to Last Bronx. Page 408.



FIVE-STAR STRATEGY

Blizzard Entertainment serves up spectacular action, scenery, and game play with Starcraft. Page 411.

After Hours



by Bob Dylan, the Steve Miller Band, and the Grateful Dead are also included. Guitar Method 2 adds a like number of lessons, each more advanced, and songs by artists

Win Swarr and Mark Valentine contributed to this story.

such as Johnny Cash, Jim Croce, and Eric Clapton.

The two CD-ROMs introduce just about every technique (strumming, hammer-ons, finger-style playing, bends, and so on) and many different styles of acoustic guitar playing. Both make good use of audio and

video. An interactive guitar tuner, a metronome, recording capability, and a chord dictionary round out the features.

Later this year, the company plans to offer additional song-collection disks for graduates of this course who want to expand their repertoires of blues, rock, and classical compositions.

Blues Guitar Explorer

Explorer Music Group's CD for blues guitar instruction is not meant for beginning players. To get the most out of this CD, you need to be able to play barre chords and understand musical scales and guitar playing techniques.

The CD contains good instructional material on blues scales, chords and vibrato, and hammer-on and pull-off techniques—plus more general information on tablature,

amplifiers, and the like. And the on-screen lessons by professional guitarist Tim Huffman quickly get into down-and-dirty electric blues playing.

The tunes you learn with this CD are actually collections of riffs introduced in the CD's lessons. You won't come away from the instruction with blues standards under your belt, but you'll develop a decent repertoire of blues scales, chord progressions, and lead riffs.

Blues Guitar Explorer makes great use of the interactive, multimedia capabilities of CD-ROM. The navigation is a bit clunky, but the production quality of every lesson is top-notch (a new version with an enhanced interface is due out this summer). You can vary the size of the videos that show Huffman playing each lesson and song, vary the videos' speed, and even switch among

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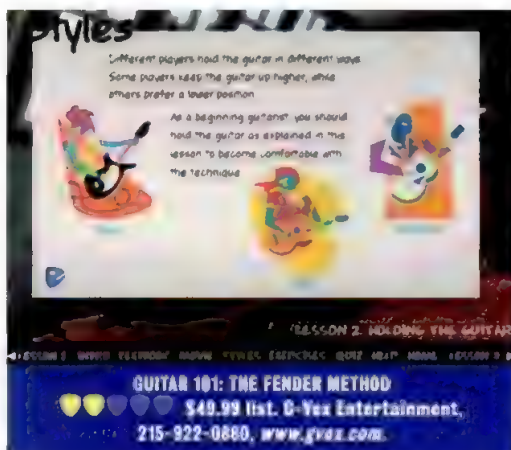
After Hours

three different views. More important, Huffman's introductions to each section and his approach to explaining and teaching blues guitar are as engaging as they are effective and complete.

If you have a yen to learn the blues, are already comfortable with playing up the neck of your instrument, and won't be put off by such terms as *flatted thirds*, you'll want to add Blues Guitar Explorer to your library.

Guitar 101: The Fender Method

This novice-guitarist instruction CD-ROM from G-Vox Entertainment offers the least effective instruction of the products reviewed



here, if what you are seeking is a quick infusion of playing ability.

The hours of detailed instruction on such rudimentary points as holding a guitar, using a pick, pressing down strings with your fretting hand, and tapping your foot to the beat are perhaps not completely wasted time. Those who have never even held a guitar may

find the \$49.99 they'll have to shell out a reasonably small price to pay to help them become comfortable with their instruments. But most students will quickly tire of the slow pace of the lessons.

Video and audio quality is first-rate. But the introduction of each lesson teases with hot riffs that students are never taught how to play as they slog through repetitious exercises of irritatingly basic lessons. The program just doesn't take you fast enough.

The company is in the midst of releasing a series of artist libraries—CD-ROMs of musical instruction by guitarists Steve Morse, Adrian Legg, and others. Also, G-Vox's CD-ROM-based songbooks with

interactive tablature of songs by B.B. King, Eric Clapton, and the Police are hitting the market this summer.

Guitar 101: The Fender Method fits in well as part of G-Vox's wide-ranging approach to PC-based guitar instruction, but as a standalone teaching product it suffers in comparison to other products.

Play Guitar

Play Guitar is the closest thing to a live teacher that a PC can provide. The material, presented by guitarist Ross Bolton, is excellent for beginners, and players with moderate experience will find it useful for reference or to augment their teachers' lessons.

The CD-ROM covers every aspect of playing the guitar and helps you put your practice to good use by teach-

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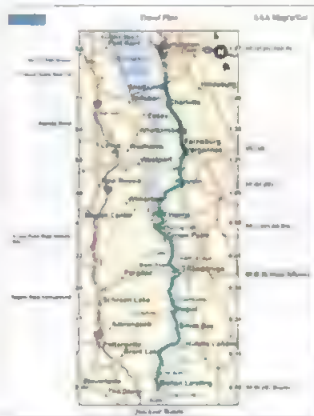
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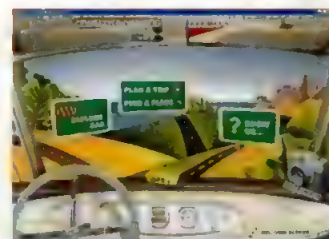
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ing you four classic rock songs—"Your Song," "Proud Mary," "Rebel Rouser," and "Rumble." Instruction is divided into four sections on chords and melodies. Each section has multiple videos, views, and references.

The graphics and videos are first-rate, offering variable speeds, views, and loop options. A lengthy glossary of terms and techniques covers topics from key signatures and quarter notes to scales and blues progressions, with clear examples and detailed voice-overs.

The lessons on the easy-to-navigate CD-ROM are appropriate for both acoustic and electric guitar players. You can even work interactively through Play Guitar's MIDI capability.

Graduates of this program will want to check out two additional CD-ROM products from Jump! Music: Play Blues Guitar and Play Rock

Guitar, each \$50 (street). These two CDs, featuring guitarist Keith Wyatt, follow the

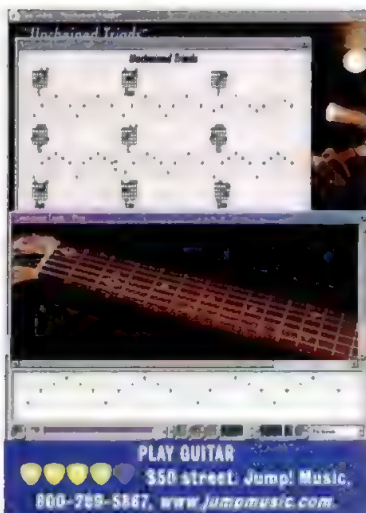
Clapton, Jeff Beck, and Jimi Hendrix. Both follow the general approach of Play Guitar and are good choices to help you hone your skills while building your repertoire.

Guitar Magic

Without pretense, Guitar Magic bills itself as a "guitar university." It is by far the most complete, in-depth, and ambitious product reviewed here. At \$99 (list), it is the

most expensive in its class, but the content of the two-CD package justifies its cost.

Guitar Magic includes more than 330 lessons and months' worth of additional tips and directions. With



The Guitar as PC Peripheral

The first thing a guitarist will ask you when he finds out you're a fellow player is "What kind of music do you play?" The second question invariably is "How many guitars do you have?" Scratch a guitarist and you'll find a guitar collector. Although many of us treasure vintage Martins, Strats, and Les Pauls, the growing popularity of PC-based guitar instruction may have more than a few of us adding Optek SmartLight guitars to our collections.

SmartLight is a line of guitars with built-in MIDI capability, letting you connect them to a PC—and an amp as well. The most striking feature of the guitars is that red LEDs are behind every fret and under every string. Responding to signals from PC-based instruction software (current versions of Guitar Magic, reviewed here, are SmartLight-ready, for example), the frets light up to show you where to place your fingers as you follow the lessons on your monitor. Through the guitar's MIDI input, the computer can detect what you're playing and match your notes against those of the lesson you're working on.

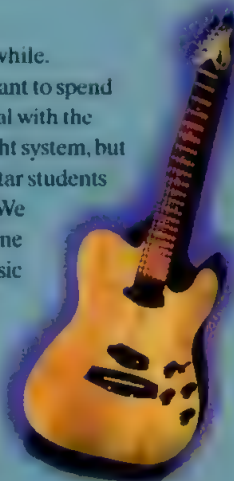
The SmartLight guitars start at \$599 and include electric, acoustic, and bass versions. They come with all the hardware and software you need to get connected to your computer and start learning. Setup is relatively straightforward for experienced PC users. Once connected, you have to adjust the controls to make sure your PC is responding correctly to what you're play-

ing, but the effort is more than worthwhile.

Many novice guitarists won't likely want to spend the money or have the motivation to deal with the connectivity challenges of the SmartLight system, but MIDI enthusiasts and hard-core PC guitar students will find the Optek systems fascinating. We tested a 1997 model, but an entire new line for 1998 is already shipping. (Optek Music Systems, Raleigh, NC; 800-833-8306; www.optekmusic.com.)

More attuned to the beginning guitarist's pocketbook is the G-Vox Guitar from G-Vox Entertainment. This \$99 system consists of an electronic pickup, which can be attached to virtually any guitar, and all the adapters, cables, and software you need to hook up your guitar to your PC. Once connected, you can use a variety of software titles from G-Vox to pursue interactive guitar lessons on your computer.

The G-Vox Guitar reproduces the notes you play on-screen, so you can follow along with the CD-ROM-based exercises and song instruction. You also can use the system to record your playing. The G-Vox Guitar lacks the gee-whiz factor of the Optek system, but at less than \$100 it's readily affordable for many PC-guitar aficionados. (G-Vox Entertainment, Philadelphia; 215-922-0880; www.gvox.com.)—JK



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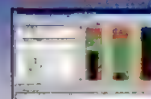
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instructional sections for novice, intermediate, and advanced guitarists, the course serves as a reference players will find useful for years. Want to know how to use a guitar strap? It's in there. Want to know how about the lydian tonality? It's just a click away. Blues? Yep. Jazz? You bet. Latin rhythms? No sweat. Record your own tunes? Step into the studio.

If not a true university, Guitar Magic is at least a complete guitar encyclopedia. And therein lies its one failing: It is encyclopedic in tone as well as presentation. Guitar Magic's fret-board demonstrations are helpful, but they lack the friendly interface and instructional videos that many of the products offer. And you won't take away any cool songs from the rock era to play at your next neighborhood party when you and the other boomers pull out your old six-strings.

If you're willing to work at getting the most from the two disks, you'll be amply reward-

ed for your effort. If you shudder remembering your fourth-grade music teacher with the metronome and scowling countenance, you'll want to opt for another product with a more friendly, though less rigorous, approach to teaching.

Classic Rock Guitar 1 and 2

These two disks from UbiSoft Entertainment are standalone products, but both take the same approach to guitar instruction: They jump right in to teach the student to play familiar songs through high-quality multimedia content. The CDs also provide lessons and exercises through supporting reference materials that the student can access.

The CD-ROMs are most appropriate for guitarists with a little playing time under their belts. Classic Rock Guitar 1 has more basic instruc-



tional material than the second disk. But both do an excellent, detailed job of walking you through the individual parts of a song, demonstrating required playing techniques at the same time that lyrics, chords, music, and tablature are laid out.

Classic Rock Guitar 1 is based on eight songs: "Sweet Home Alabama," "Dust in the Wind," "Blackbird," "Hey Joe," "No Woman No Cry," "Wild World," "Blowin' in the Wind," and "Life by the Drop." Volume 2 contains the Beatles hits

"Yesterday," "You've Got to Hide Your Love Away," "Blackbird," "Michelle," "Across the Universe," "Help!," "Let It Be," and "Norwegian Wood." All songs are presented for acoustic guitar.

The videos—with loop capability—are well done. And the mix of chord charts, tablature, and fret-board views of the lessons are straightforward and

effective. The home screens of the disks are a bit bare, and the navigation procedures are not immediately obvious. But with the help of the short manuals included with each disk, students will quickly get the hang of finding the material they want to work on.

Classic Rock Guitar does not pretend to be a thorough course of guitar instruction for beginning students, but intermediate players who would like to add these songs to their play lists will find both disks worthwhile.

QUICK CLIPS

Easy Language: 25 World Languages

A super-useful language tutorial for those who travel the world for business or pleasure. Learn the essential vocabulary, pronunciation, and cultural history of 25 languages, from Arabic to Thai. \$35 street; IMSI, 800-883-8082.

Last Bronx

You battle against eight martial arts experts—complete with weapons and killer moves—in this street-fighting affair. The graphics are decent, but in the end the game's just like every other fighting game, and it gets old quick. \$35 street; Sega Entertainment, 888-734-7253.



Shadow Master

Fans of the fantasy artwork of Rodney Matthews will no doubt be captivated by the graphics of this first-person shooter game, in which you command a tanklike vehicle through enemy territory. The lackluster game play, however, is anything but fantastical. \$49.99 list; Psygnosis, 800-438-7794.

BASS Masters Classic Tournament Edition

Cast your line, sit back, and wait for a nibble. Does that sound like fun? It is when you're playing in the 3-D world of BASS Masters. Fish four actual U.S. lakes, play single-player or over a network, and use your force-feedback joystick for added realism. \$39.95 list; THQ, 818-225-5167.

SimSafari

Instead of creating a burgeoning metropolis à la SimCity, this game invites kids ages 8 and older to conquer the African savanna by designing and running a safari park and camp. \$30 street; Maxis, 800-245-4525.



The Little Wizard

Not the usual child's fare, this adventure for kids ages 3 to 8 teaches reading, math, and decision-making skills. Random animations and quirky characters will keep little ones engaged. \$29.95 list; Gizmo Gypsies, 888-464-4966.

Natural Appeal

DeluxScan Monitors

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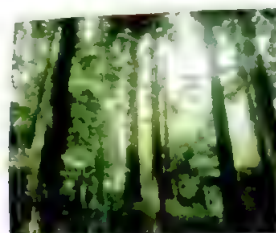


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* Windows 98 ICM profile: For display-to-printer WYSIWYG, Windows 98 requires ICM (Image Color Matching) profile for the display monitor. This profile is available free of charge at the place of purchase, or directly from Hyundai.



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Starcraft Soars

The long-awaited sci-fi strategy game lives up to gamers' high expectations.

Many games can rightfully claim the status of *eagerly anticipated* but none more so than Blizzard's Starcraft. Surrounded by hype and plagued by delays, this real-time strategy game finally made it out of the gate in April. How does it rate in a genre that now boasts Dark Reign and Total Annihilation? With impressive graphics, a fantastic plot, and addictive game play in both single and multiplayer modes, Starcraft delivers the goods as promised.

In terms of game play, Starcraft is similar to Blizzard's Warcraft titles. You start each mission with a small force,

which you fortify by building training facilities and finance by harvesting natural resources. Your goal is usually to wipe out your opponent's force, though a few other types of missions (such as commando-style raids) help keep things fresh. Battles in Starcraft can take place on land, in space, and indoors.

The game revolves around the conflicts among three species, each with its own arsenal and style of combat. The Terrans, for example, use a lot of conventional heavy weapons, and

the Zerg are a buglike race that relies on swarms of smaller, faster creatures. Starcraft's 30 missions are split into three chapters; each is played from a different species' point of view.

Starcraft uses an impressive

and add a tremendous amount of atmosphere to the game.

The game includes a mission and campaign editor, as well as numerous multiplayer modes that are playable over modem, serial, IPX LAN, and

Internet links. Internet play is accessible through Battle.net, Blizzard's free online gaming service. Multiplayer game options include free-for-all and team play. Starcraft has modest hardware requirements: a Pentium/90 running Windows 95 with 16MB of RAM. We recommend a Pentium/133 with at least 32MB of RAM.

When you total up Starcraft's impressive features, you get the most complete real-time strategy game we've seen to date.—*Michael E. Ryan*



Coming Up

What's in the Next Issue of *PC Magazine*

Windows 98 Put to the Test

We gave you a preview of what's coming. Now we've tested the shipping code. We'll let you know whether the promises are true. Is performance improved? How well does the new hardware support work? Will notebook PC users be better off with Windows 98?

Portable PCs

Whether you're looking to buy a high-end, value, or subnotebook portable PC, we've got them all in this roundup. Find out which of the more than 50 we review is the lightest, fastest, and most powerful. And our updated Road Warrior Guide gives you everything a business traveler needs, such as the phone numbers and URLs for car rental agencies and hotels and the access numbers for online services and ISPs.

Portable Data Projectors

It's easier than ever to take your presentations on the road. Data projectors are getting lighter, brighter, and more powerful, and many can support high screen resolutions, as well as audio and video. We test and review 30 projectors that cost under \$10,000 each. Most weigh less than 15 pounds, and a few even weigh less than 10.



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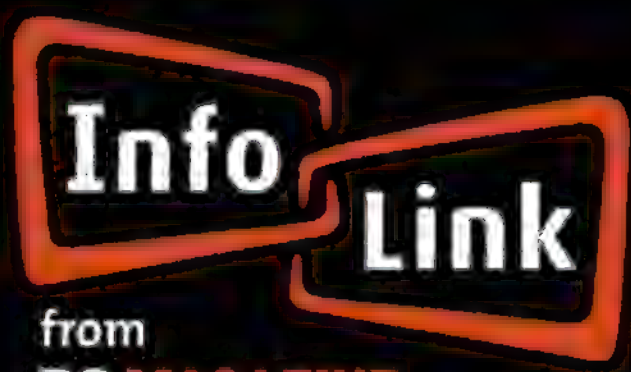
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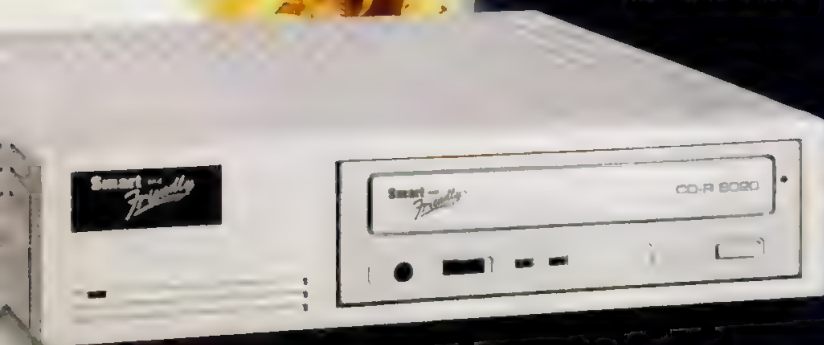
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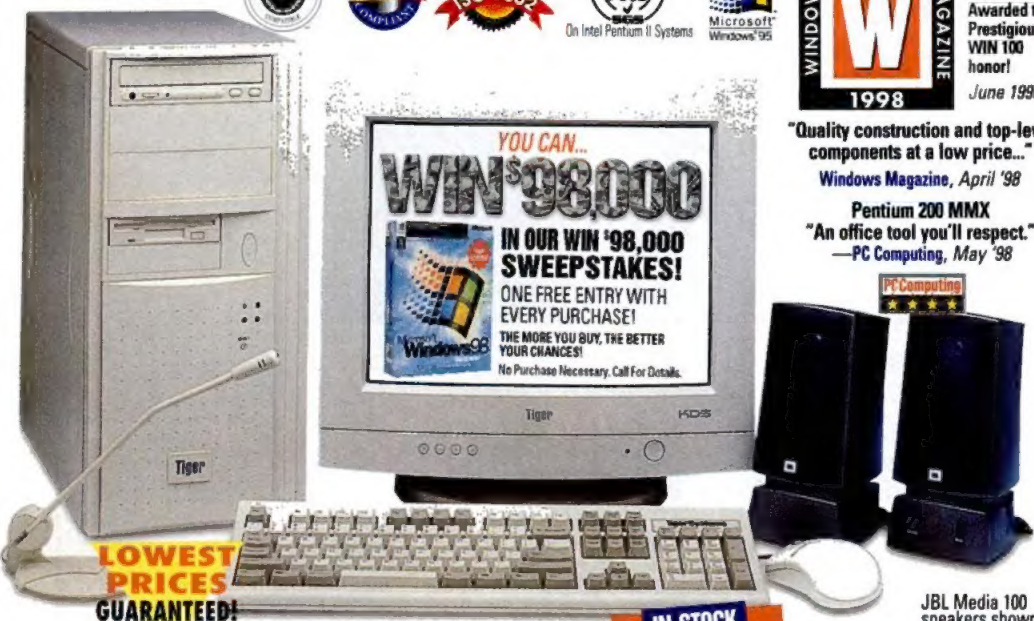
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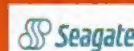
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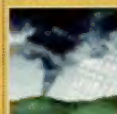
Abort, Retry, Fail?

USA TODAY Weather

TOPICS

EXTREMES

ASK JACK



**Celebrating
50 years of
tornado
forecasts**

Weather weirdness.
"Celebrating?"
We would have
picked a different
word. (USA
Today Online.)

Rolling Stone 25 Years of Essential Rock

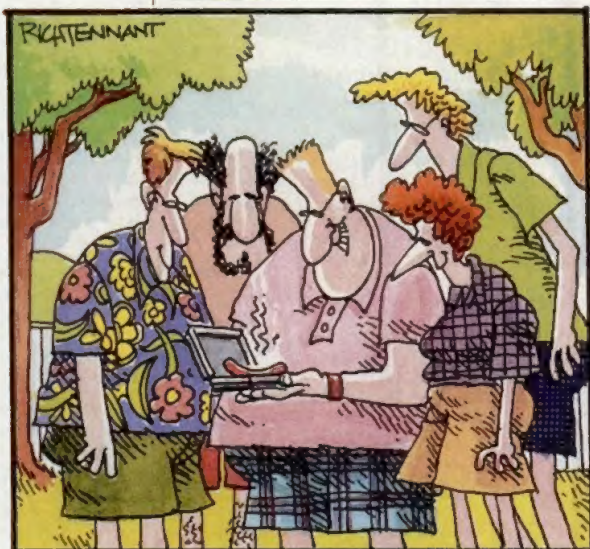
Seven CD's packed with 25 years of great rock & roll -- 110 tracks in all -- including Walk on the Wild Side - Lou Reed; Like a Rolling Stone - Bob



Doo—
doo doo—click!
You'd think Rolling
Stone Online would
get Lou Reed song
titles right.

Might as Well Go Home

Here's a recent memo distributed to the staff of a small company in Nashville: "Effective 3/30, requests for the resetting of a computer password must be submitted in writing by e-mail. Requests for the resetting of passwords by telephone or walk-ins to the Help desk will not be accepted." So you can't log on without a password, and you can't get a password without logging on. Hmmm.



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'38.
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This Phone Company Kicks Ass

"A telephone company found a low-tech solution for the high-tech problem of hooking North-western Pennsylvania customers up to the Internet: a pair of mules named Maggie and Mandy. The mules pulled more than 6,500 feet of fiber-optic cable into place Monday along U.S. Route 19 just south of Meadville."

—ASSOCIATED PRESS



How the well-dressed woman explores the Web.
(Harry's Shoes ad.)

Syracuse, NY 34°...38°F
Cold, Light rain
Utica, NY 31°...39°F
Warm, Peanuts



The new meteorologist at Excite must be George Washington Carver.

If your entry is used, we'll send you \$50 and a PC Magazine T-shirt. Send your entries to Abort, Retry, Fail?, PC Magazine, One Park Ave., New York, NY 10016-5802. Winners this issue: Susan Blanc, Sal Cuccia, Mary H., Ruben Lopez, Gene Sally, and Stan Showalter.

VICTORY.



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